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ABSTRACT

Energy activities and lesson plans for grades 6, 7, and 8 (grouped into seven units representing seven major conceptual schemes) are provided in this teachers' guide, with a unit at each grade level for each conceptual scheme. Conceptual schemes addressed include: (1) energy is the ability to do work; (2) energy comes from the sun; (3) energy can be changed from one form to another; (4) the sun is the earth's chief source of radiant energy; (5) people use energy to satisfy their needs; (6) energy supplies are limited; and (7) living things are interdependent with one another and with their environment. Each unit includes a pre-/post-test evaluation instrument, lesson plans, and supplemental activities. Lesson plans consist of a specific energy concept, objective, and instructional strategies for introducing, developing, and extending the lesson. Purpose, materials, and procedures are provided for each of the supplemental student activities. The guide begins with a brief introduction to teachers and statement of the energy policy for Florida and concludes with a list of key vocabulary words (Enerwords), bibliography, sources of energy information and teaching materials, and an evaluation sheet. (JN)

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ENERGY & MY ENVIRONMENT

6-8 TEACHERS GUIDE

SE038816

Governor's Energy Office / State of Florida
SAVE IT, FLORIDA.

ENERGY AND MY ENVIRONMENT

TEACHERS' GUIDE

FOR

GRADE SIX, GRADE SEVEN, GRADE EIGHT

Written by:
Matthew J. Brennan, Ph.D.

Series Editors:

Rosalyn B. Tillis
C. Richard Tillis

June 1982

Governor's Energy Office
State of Florida

We are all parts of the great Web of Life - -
Powered by the Sun - -
All interdependent with the others... .

John H. Storer
1938

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FOREWORD

This Grade Six through Grade Eight teachers' guide is the third of a series entitled ENERGY AND MY ENVIRONMENT. Other volumes of this series are:

ENERGY AND MY ENVIRONMENT, K - 3 Teachers Guide
ENERGY AND MY ENVIRONMENT, 4 - 6 Teachers Guide
ENERGY AND MY ENVIRONMENT, 9 - 10 Teachers Guide
ENERGY AND MY ENVIRONMENT, 11 - 12 Teachers Guide

After participating in many curriculum development and educational planning projects, the editors recognized one element that permeates those which were most successful. That element is the establishment of major ideas which serve as recurring themes throughout the child's educational experiences. This publication is designed to integrate key energy and energy conservation ideas in just such a manner.

The State of Florida was most fortunate indeed in obtaining the services of Dr. Matthew J. Brennan as the author of this series of teachers' guides. His work as editor on the PEOPLE AND THEIR ENVIRONMENT series established him as one of the founders and principal practitioners of this cognitive theme approach.

Through the Tri-County Teacher Education Center, Sebring, Florida, teachers were employed to select supplemental activities to accompany the lessons prepared by Dr. Brennan. Funds for this activity were provided through the mini-grant program of the Office of Energy and Environmental Education, Florida Department of Education.

These materials are designed to provide the flexibility which any good teacher demands, yet provide the recurring themes which may well be essential if the lessons are to have any lasting impact on the student. These materials can play an important role in the development of a citizenry that thinks and acts on a basis of factual knowledge of key energy concepts and also possesses an understanding of the great national and international web of energy relationships and interdependencies important for the citizen of today and essential for the citizens of the future.

The editors wish to thank the dedicated educators who have contributed their time and expertise to make this series, ENERGY AND MY ENVIRONMENT, available to the teachers in Florida. A special thank-you goes to secretaries Edie Boynton and Patricia Patrick for the long hours spent preparing these manuscripts for printing, and to Mary Lou Stursa and Dr. Rodney Allen for their expert assistance.

The Editors

INTRODUCTION - TO THE TEACHER

Is there an "energy crisis"? There has always been an energy crisis, as humans struggled to survive on planet earth. Now we face a new energy crisis - a crisis related to the future supply of the fossil fuels on which our civilization depends. This new energy crisis provides unlimited possibilities for student activities that will help children learn about the earth, how the use of energy has shaped civilizations of the past and present, and how it will determine the civilizations of the future.

Through their use of energy, humans have radically changed the environment. Now we must face the consequences of these changes, not only on the environment, but on all of life, including our own; on our societies; on our economies; on the air we breathe and the water we drink; on the lifestyles we lead; on the quality of the environment; and on the lives of the animals with whom we share the earth. The changes were made by people. The problems they have created can be solved only by people - indeed, by people who wish to solve them.

So we have reached the "crisis." The fossil fuels, which gave us unlimited supplies of cheap energy, are being depleted rapidly. The time for decision has arrived. How will we answer? We have the technology to solve most of the energy-related problems of the earth environment. Whether we solve these problems will depend on how clearly they are recognized and whether our values will demand their solution. It is hoped that the activities in this guide will help students to understand the scientific, social, and aesthetic alternatives that must be considered.

The activities have been organized around the seven major conceptual schemes relating to energy, with a unit at each grade level for each one of the conceptual schemes. In addition, there is a lesson concept for each lesson and supplemental activities to help the teacher coordinate the activities with other areas of the curriculum. Each lesson is designed to suggest some activity, with the emphasis on "suggest," because students and teachers will be free to interpret each activity suggestion as they will.

You will have many ideas for variation and improvement of the lessons suggested and the supplemental activities.

PLEASE RETURN THE REVIEW SHEETS LOCATED IN THE BACK OF THIS BOOK. IT IS NECESSARY THAT WE HAVE INFORMATION FROM YOU FOR EVALUATION PURPOSES.

ENERGY POLICY FOR FLORIDA

WHEREAS, energy availability strongly impacts upon every aspect of human existence and the conservation of energy resources is essential to the health, safety, and welfare of the people of this state and to the well-being of the state economy, and

WHEREAS, Florida is particularly dependent upon other states and nations to supply its energy needs, and

WHEREAS, the majority of Florida's energy requirements are obtained from petroleum and natural gas, and the supply of these fuels is subject to interruption, and

WHEREAS, wasteful, inefficient, uneconomic, and unnecessary use of energy will result in a serious depletion of energy resources and represents a potential threat to preserving the health, safety, and welfare of the people of Florida, and

WHEREAS, alternative sources of energy are years from being fully developed and there is a pressing need to accelerate research and development of these sources, and

WHEREAS, energy conservation represents a meaningful, immediate, and appropriate state response to the energy problem by eliminating waste and inefficiency and increasing economic productivity, by reducing the depletion of our domestic energy resources which, in turn, increases economic flexibility of the people of Florida, and by decreasing the pressure to develop marginally efficient methods of energy production and thereby reducing the flow of capital from the non-energy sections of the economy and avoiding serious impacts on our environment, NOW, THEREFORE, BE IT RESOLVED

IT SHALL BE THE POLICY OF THE STATE OF FLORIDA TO:

1. Develop and promote the effective use of energy in the state and discourage all forms of energy waste.

2. Play a leading role in developing and instituting energy management programs aimed at promoting energy conservation.

3. Include energy considerations in all planning.

4. Utilize and manage effectively energy resources used within state agencies.

5. Encourage local governments to include energy considerations in all planning and to support their work in promoting energy management programs.

6. Include the full participation of citizens in the development and implementation of energy programs.

7. Consider in its decisions the energy needs of each economic sector, including residential, industrial, commercial, agricultural and governmental uses.

8. Promote energy education and the public dissemination of information on energy and its environmental, economic and social impact.

9. Encourage the research, development, demonstration, and application of alternative energy resources, particularly renewable energy resources.

10. Consider in its decision making the social, economic and environmental impacts of energy-related activities, so that detrimental effects of these activities are understood and minimized.

11. Develop and maintain energy emergency preparedness plans to minimize the effects within Florida of an energy shortage.

(Chapter 377.601, Florida Statutes)

GRADE SIX

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ENERGY TEST - GRADE 6

A Pre-Test and Post-Test Evaluation Instrument

1. What is a calorie? (the amount of heat energy needed to raise the temperature of one cubic centimeter - 1 gram - of water one degree Celsius, at sea level)

2. Construct an energy chain for an appliance. (uses energy for raw materials, production, packaging, delivery, use, disposal)

3. List five ways of preserving energy (foods) for storage. (salting, drying in sun, canning, freezing, smoking)

4. The loss of energy in the operation of an electric power plant can be as high as:

   a. two-thirds (correct answer)
   b. one-half
   c. one-third
   d. one-fourth

5. Give three reasons for the warm climate of Florida. (geographic location, amount of sun, intensity of sun, angle of sun's rays, Gulf Stream, Gulf of Mexico)

6. How does Florida's warm climate affect the following:

   a. population (growing, retirees, diverse)
   b. tourism (winter visitors)
   c. industry (fishing, water sports, winter crops, housing)
   d. wildlife (winter home for birds)
   e. energy use (more energy for cooling, less energy for heat)

7. Compare truck and rail transportation for:

   a. speed (truck faster)
   b. delivery (truck more direct)
   c. labor (trucks use many more people to drive)
   d. energy use (trucks use much more fuel)

8. What fuel is in shortest supply in the world? (wood for cooking)

9. What is the effect of people's use of dried animal manure as fuel? (loss of fertilizer to grow food)

10. How are the limits of supply of all energy sources related? (scarcity of any one source affects the others - less oil means less fertilizer means less food, etc.)

11. How can nations use energy supplies to influence the actions of other nations? (Arab oil embargo, Mexican gas pricing)

12. What are synthetics? (petroleum-based substitute products such as plastics, fertilizers, fibers)

ENERGY TEST - GRADE 6 (Continued)

13. What are the 2 biggest uses of crude oil? (gasoline and heating oil)

14. What traffic law was passed to save gasoline? (55 mph speed limit on highways)

15. What type of transportation uses more than half of all the gasoline produced? (automobiles)

Title: A Calorie Count

Concept: Energy comes in many forms.

Objective: To discover the relationship between food types and the amount of energy they contain

Introducing the lesson:

1. Make a bulletin board display of overweight people doing something, preferably eating.

2. Add some magazine articles or advertisements for programs to lose weight easily or quickly or both.

3. Ask the students to keep a record of everything they eat or drink for a week so they can calculate their calorie intake.

4. Weigh and record weight of each student at the beginning of the week.

Developing the lesson:

1. Determine the definition of a calorie. (A calorie is the amount of heat needed to raise the temperature of one cubic centimeter - one gram - of water one degree Celsius at sea level.)

2. To show the relationship between food and the production of heat:

   a. Fill a pyrex test tube half full of cold water. Have a student hold half of an English walnut on the end of a piece of insulated wire, or on a wooden-handled needle.

   b. Hold, with tongs, the test tube over a sand-filled pie plate. Light the walnut with a match and hold the burning walnut under the test tube.

   c. When the water starts to boil ask: Is the walnut we are using here a food or a fuel? (A fuel - man is the only living thing that uses fire. Other living things would use the walnut only as food. Man also uses walnuts as food.)

3. Ask the students to suggest an investigation to measure the calories in half a walnut. (Measure weight of nut and temperature of water before and after burning. How many cubic centimeters of water can you boil with how much walnut?)

4. Determine from a calorie chart the calorie content of:

a.	ice cream	f.	cola drink
b.	banana	g.	your favorite dessert
c.	peanut butter	h.	cookie
d.	jelly	i.	steak
e.	donut	j.	cake and pie

5. Ask the students to investigate what other foods in their local supermarket are "diet" foods.

6. Ask: What is the source of calories in a soft drink?
What is diet cola?
What is the substitute "sweetener" in diet foods? (Read the food package labels.)

Extending the lesson:

1. At the end of the week, have each student calculate the number of calories per day taken into their bodies.

2. Compare their figures with recommended amounts for sixth graders.

3. Compare total calorie intake of students in the class.

4. Identify the "big eaters" and the dieters.

5. Compare the calorie values of regular meals with "snacks."

6. Investigate the role of the Food and Drug Administration regarding materials used in food.

7. Investigate the possible harmful effects of sugar substitutes to human health. Ask: Why is there a warning label on products containing saccharine?

8. Draw a picture of yourself enjoying your favorite meal or snack.

9. Put a funny caption on your picture.

10. Have the students weigh themselves again and compare their weight with their weight at the beginning of this lesson.

11. Start a list of energy words learned in this lesson - an energy vocabulary -- "ENERWORDS."

12. Ask the students to use one of the "ENERWORDS" in a story of their eating habits.

Materials: food calorie chart
pyrex test tube
English walnuts
tongs
insulated wire or wooden-handled needle
sand-filled pie plate

Title: "Power"

Concept: Energy comes in many forms.

Objective: To develop a concept of "power"

Introducing the lesson:

1. Ask the students to find photographs or magazine pictures which demonstrate "power."
2. Make a bulletin board display of "power."

Developing the lesson:

1. Ask the students to find examples of different kinds of power. (electric power, people power, body power, fast power, slow power, silent power, noisy power, any other kind of power, "me" power)
2. Draw a picture of a friend using power.
3. Put yourself in the picture to change the power being used by your friend.

Extending the lesson:

1. Have students classify the class power pictures, placing them in order from the most powerful to the least powerful.
2. Classify them in another way.
3. Take the class on a field trip to your local electric power plant.
4. Investigate the community use of electric power.
5. Identify the big power users.
6. Write a paragraph describing power.
7. Add to the class energy word list.

Title: An Appliance "Energy Chain"

Concept: Energy can be changed from one form to another.

Objective: To discover the relationship between the appliances students use and the energy needed to produce and operate them

Introducing the lesson:

1. Develop a food energy chain that starts with:

   a. a cereal
   b. a water plant
   c. a tree

2. Relate a food energy chain to an appliance energy chain.

3. Ask each student to make a list of all the appliances they use.

Developing the lesson:

1. Ask the students to pretend that their favorite appliance is alive and construct an "energy chain" for that appliance similar to a food energy chain.

2. Ask: Why is it more difficult to construct an energy chain for an appliance than for a food chain? (Appliances use energy for raw materials, construction, packaging, delivery, as well as use.)

Extending the lesson:

1. Construct an energy chain for an object that is not an appliance; for example, an automobile.

2. Compare relative use of energy in the various stages of appliance development and use.

3. Compare energy use for the appliances on the class list.

4. Draw a picture of your life without your favorite appliance.

5. Describe your picture.

6. Write a paragraph describing how your favorite appliance has changed the lifestyles of people.

7. Add to the class energy word list.

Title: Concentrated Energy

Concept: Energy can be changed from one form to another.

Objective: To discover the relationship between amounts of energy and the kinds of storage used

Introducing the lesson:

1. Have the students investigate the preparation and use of dehydrated foods by hikers, campers and explorers.

2. Ask: Why did people want to have their food energy sources in a concentrated form? (Without water, food has less weight and bulk. Water is added to food at time of cooking.)

3. Investigate other methods of food energy concentration for storage. (A cake or candy is concentrated energy.)

Developing the lesson:

1. Investigate the process for preparing frozen orange juice concentrate.

2. Ask: How has the frozen food industry changed the eating habits of people? (Before frozen foods, all fresh foods were available only at the time of harvest. Now, fresh food are available all year long.)

3. Investigate other methods of food concentration or preservation for storage. (dehydration by drying in the sun, salting, or smoking)

Extending the lesson:

1. Investigate methods of canning.

2. Investigate "old-time" methods of food concentration by explorers, such as "jerky" and "pemmican."

3. Ask: What was the principal ingredient of these concentrated foods? (fat)

4. Make a list of the foods you would have to give up if electricity shortages dictated no further use of electricity for freezing.

5. Draw a picture of your family life without your freezer or the freezer in the local supermarket.

6. Describe your picture.

7. Add to the class energy word list.

Title: Heat Is Lost

Concept: Energy can be changed from one form to another.

Objective: To discover the relationshiop between energy change and loss of heat.

Introducing the lesson:

1. Have students find advertisements in newspapers and magazines for products to reduce heat loss in homes, engines, and machines.

2. Make a bulletin board display of the different kinds of advertisements for products designed to reduce heat loss.

Developing the lesson:

1. Ask: What do we call products that reduce heat loss? (insulation, lubricants, etc.)

2. Ask: Where did all this excess heat come from? (burning of fuels, friction, etc.)

3. Did any of the students find an advertisement claiming to eliminate heat loss entirely? (Look for home insulation advertisements.)

4. Investigate the loss of energy (heat) in the operation of an electric power plant. (Loss is estimated to be as much as two-thirds of the energy used - coal, oil, nuclear.)

Extending the lesson:

1. Invent a way to utilize the wasted heat from an electric power plant.

2. Discuss the reasons why this heat probably could not be used as you suggested. (Power plants too far away from cities to use heat to heat homes or offices; too costly to transport hot water without losing heat from pipes.)

3. Draw a picture of yourself or a friend enjoying wasted heat.

4. Investigate the effectiveness of various types of thicknesses of insulation materials for buildings.

5. Invent a way to keep an ice cube from melting in your hand.

6. Have a class contest to see who has invented the best way to keep the ice cube from melting.

7. Compare the melting time with an ice cube without any covering or insulation.

8. Add to the class energy word list.

Title: Energy Inventors

Concept: Environments are in constant change.

Objective: To learn about the inventors and scientists whose work made our high energy society possible and the changes that resulted from their inventions, both to people and to their environment

Introducing the lesson:

1. Read about the inventions of Thomas Alva Edison.
2. Ask the students to describe the first light bulb, battery, and power station.

Developing the lesson:

1. Investigate the work of Watt, Volta, Ohm, Ampere, Faraday, Black, Fahrenheit, Celsius, Franklin, Joule, Carnot, Young, Einstein, Fermi, and Galileo.
2. Ask: Why do some of these names seem familiar? (Many of their inventions were named for them.)
3. Ask: What is a kilowatt? (1000 watts)
4. Write a letter to Thomas Edison describing the effect his inventions have had on your life and the life of the community.

Extending the lesson:

1. Read about the work of Henry Ford and John D. Rockefeller in the development of energy and transportation.
2. Ask: What effect has the automobile and gasoline had on the lifestyles of people?
3. Discuss the changes that resulted from other energy inventions and discoveries. (steam engine, nuclear, etc.)
4. Draw a picture of your life without gasoline or electricity.
5. Add to the class energy word list.

Title: The Sun Affects Our Climate

Concept: The sun is the chief source of the earth's energy.

Objective: To discover the relationship between solar energy and the climates of the world

Introducing the lesson:

1. Have the students collect advertisements featuring the climate of Florida.
2. Make a bulletin board display of the advertisements.
3. Ask: What can we learn about the attraction of the climate of Florida on the housing, tourist, fishing, and other industries?

Developing the lesson:

1. Investigate the reasons for Florida's warm climate. (geographical location, amount and intensity of the sun, angle of the sun's rays, etc.)
2. Ask: What does the term "tropical" mean?
3. Compare the length of daylight and the average yearly temperature of your community in Florida with Chicago, Atlanta, Washington, D.C., and Anchorage, Alaska.
4. Consider other factors which influence Florida's climate that are indirectly related to the radiant energy of the sun. (Gulf stream, warm waters of the Gulf of Mexico, summer showers)

Extending the lesson:

1. Investigate the effects of Florida's warm, sunny climate on:
   a. population - growing rapidly, older than average
   b. tourism - a warm winter vacation place
   c. industry - fishing, housing, agriculture (winter crops)
   d. wildlife - winter home
   e. any other
2. Draw a picture of a tourist enjoying a Florida vacation.
3. Describe your picture, telling how the climate affected the activities shown in your picture.

4. Discuss the harmful effects of the Florida sunshine. (sunburn, skin cancer, etc.)

5. Write a letter to a northern friend telling of the "wonderful climate" of your area of Florida.

6. Design a billboard to be placed along northern highways telling people about Florida's climate and the lifestyles of people.

7. Add to the class energy word list.

Title: People Worship the Sun

Concept: Solar energy can be used directly.

Objective: To discover how people throughout the ages have worshipped the sun and its energy

Introducing the lesson:

1. Ask the students to collect pictures of the sun, sunrises, and sunsets.

2. Make a bulletin board display of the pictures.

Developing the lesson:

1. Ask the students to draw a picture that expresses their feelings about the sun.

2. Find examples of modern "sun worship."

3. Ask: How has modern sun worship affected industries in Florida? (suntan lotions, retirement, vacations)

Extending the lesson:

1. Investigate the worship of the sun god RA in ancient Egypt. (inscriptions on inside walls of pyramids of Sixth Dynasty - 2500 B.C., the "Pyramid Texts," in which the sun god RA carried the Pharoah's soul on his skyboat into the West, where lay the land of the dead)

2. Read in the National Geographic magazine for November 1970, about the restoration of Akhenaton's Temple to Aten, the solar disc.

3. Investigate the Akhenaton concept of a single supreme sun god. (the solar disc - the unification of all the former sun gods into one image of Aten) This concept influenced religious thought in the Middle East until the time of Jesus and Muhammed.

4. Read and discuss this passage from the Vedic Hymns (Hindu), circa 1400 B.C.: "And when the Sun arose, they could not understand how this newborn God could wield such power. And they said: Let us worship this Child of Sky. He stands up as a mighty flame; he stretches wide his arms; he is everywhere like the wind."

5. Investigate this Vedic concept's influence on the writings of Thoreau. (See Walden, Chapter 2, for insight into Thoreau's regard of the sun as the visible symbol of some yet-to-be-evolved human grandeur. Throughout Walden, he compares daybreak with spiritual awakening.)

6. Have one of the students read Walt Whitman's "Song of Myself." (a primitive psychological idea that light from an inner sun is emitted through the eyes and mixes with the eternal light of the sun to make visual perception possible -- a notion as old as Empedocles, 5th Century B.C.)

7. Investigate the "CIWILTKONIA", a sun ceremony of the Papago Indians of the southwestern U.S. (Dancers circle a sand painting of the sun and thereby recharge themselves with its life-giving energy.)

8. Make up a "CIWILTKONIA" dance.

9. Do it!

10. Read to the class Franz Boas' description of the "Prayer at Sunrise" of the Kwakiutl Indians of the Pacific northwest, and ask the students to discuss: "Welcome, Great Chief, Father, as you come and show yourself this morning. Let nothing evil befall on me this day which you have fashioned according to your wishes, Great One, Walker-Across-The-World, Chief."

11. Draw a picture to express your own feelings about a sunrise.

12. Describe your picture.

13. Add to the class energy word list.

Title: Energy For Transportation

Concept: Energy is used to move things.

Objective: To discover the relationship between energy use and transportation

Introducing the lesson:

1. Take the class out to a place on the school grounds where they can see a highway.
2. Ask the students to investigate and list what is being transported during a twenty-minute period.

Developing the lesson:

1. Make a class list of what was being transported.
2. Was most of the material being transported locally or from out of state?
3. Ask the students to suggest a way that each material could be moved using less energy.
4. Investigate the relative energy use for trucks and trains in transporting goods.
5. List the advantages and disadvantages of truck and railroad transportation. (speed, delivery, labor, etc.)

Extending the lesson:

1. Investigate people's use of energy for transportation:

   a. needs (basic to survival)
   b. wants (do not need for survival)
   c. dreams (may never get)

2. Ask the students to check their own use of energy for transportation.
3. Ask the students to draw a picture of their transportation dream.
4. Investigate your community's needs for transportation.
5. Ask: Why have the railroads declined in popularity?
6. Compare how cattle are transported today with 100 years ago. (cattle drives)
7. Compare transportation in USA with other nations.
8. Add to the class energy list.

Title: Energy Use in Other Nations

Concept: People use energy to satisfy their needs.

Objective: To discover the patterns of energy use in other nations

Introducing the lesson:

1. Have students bring in pictures showing how people use energy in other nations.
2. Make a poster for each nation. Paste each nation's pictures on the appropriate poster.
3. Group the "developed" and the "under-developed" nations on the basis of energy use.

Developing the lesson:

1. Consider energy use for basic needs:
   a. cooking
   b. food production
   c. shelter, including heat and light
2. List the nations that use wood as the principal cooking fuel.
3. Do the same for peat, natural gas, coal, oil, electricity.
4. Find the places that do their work by:
   a. solar energy (animal and body power)
   b. wind power
   c. water power
   d. electric power
   e. all of these

Extending the lesson:

1. Investigate changes in the lifestyles of people in the USA as a result of changes in primary energy sources. (from wood to coal to oil to electric, nuclear, solar)
2. Do the same for people in other places - Eskimo, Arab, Chinese, etc.
3. Predict future changes as oil supplies are depleted.
4. Draw a picture of someone changing a lifestyle as a result of the discovery of a new and unlimited source of energy.
5. Describe your picture to the class.
6. Add to the class energy word list.

Title: A "Do-it-Yourself" Blackout

Concept: Energy supplies are limited.

Objective: To discover the relationship between lifestyles and energy supply availability

Introducing the lesson:

1. Tell the students that you are going to ask them to plan a "do-it-yourself" blackout in your school. (no electricity)
2. Ask for suggestions for the class plan.

Developing the lesson:

1. Divide the class into committees to discuss and outline parts of the plan. (Let the students decide what committees are needed.)
2. Have each committee suggest alternative energy sources for heating, lighting, cooking, etc.
3. Have the committees report to the class for suggestions and approval.
4. Draw up a consensus blackout plan.
5. Get the principal's permission to put your plan into operation.
6. Pull the plug!
7. Caution: Turning everything back on at the same time could increase demand charges. Schedule "turn ons."

Extending the lesson:

1. Develop additional plans to reduce the amount and length of time you must use artificial lighting, heating, cooking, etc. in the school.
2. Plan a blackout for your home and report back to the class.
3. Draw a picture of yourself before and during the blackout.
4. Write a story describing your school without electricity.
5. Add to the class energy word list.

Title: A World Without Energy

Concept: Energy is essential for the future of humankind.

Objective: To discover the relationship between the future of energy supplies and the future of humankind

Introducing the lesson:

1. Say: Some experts predict that, at the presently increasing rate of energy consumption, the world may be out of oil soon after the year 2000 A.D. Ask the students to think of their world without oil.

2. Ask the students to draw a picture of their community on the day the oil supplies run out.

Developing the lesson:

1. Describe your environment without oil and oil products - heating oil, gasoline, lubricants, plastics, fibers.

2. Have each student survey their room at home to see what would be left if they took everything out that was made of synthetic materials.

3. How would that room compare with a room in a pioneer homestead? (similar, all wood construction)

Extending the lesson:

1. Describe a world without wood, coal, natural gas.

2. It has been said that if the U.S. gave the hungry people of the world all the food they needed, they would not have the fuel to cook it. Discuss this situation with the class. Investigate people's search for wood for cooking.

3. Investigate results of people's use of dried animal manure as fuel. (loss of fertilizer to keep soil rich)

4. Ask: How is man planning for future energy supplies? (In many cases the research being done may be too late, as supplies forecasted dwindle and the deserts of the world spread.)

6. Investigate the limits of energy supplies and how they are related:

a. food	b. oil	c. coal
d. nuclear	e. solar	f. natural gas

7. List the environmental problems of increasing the supplies of each.

8. Add to the class energy word list.

Title: Lifestyles and Energy

Concept: People depend on the environment for their energy.

Objective: To discover the relationship between energy supplies and our standard of living

Introducting the lesson:

1. Ask the students to invent a way to compare the energy demand for the basic needs; the "wants"; and the dreams of people.

2. Ask them to share their inventions with the class.

Developing the lesson:

1. Have the students devise an energy formula that measures the differences between people's energy "needs" and energy "wants."

2. Draw a class mural that shows how energy shortages cause changes in societies and the way people live. (lifestyles)

3. Discuss how such changes in people and societies could lead to conflict.

4. Have students write stories about their present lifestyles in comparison to their "needs," "wants," and "dreams."

Extending the lesson:

1. Show how governments and people use energy supplies to make other governments and people do things they want. (oil embargo, food exports, etc.)

2. Compare energy needs and wants in the U.S. with those in other nations.

3. Compare different energy needs and lifestyles within the U.S.

4. Do the same for your community. (How many private airplanes are there, for example?)

5. Create a dance, a verse for a song, a poem or a picture which shows how we use energy to maintain our lifestyle or standard of living.

6. Share your creation.

7. Add to the class energy word list.

Title: Energy Waste -- Or -- Conservation?

Concept: Energy can be saved through a program of energy conservation.

Objective: To discover the relationship between energy shortage, waste, and conservation

Introducing the lesson:

1. Take the class on a survey of the school to identify energy waste.
2. Ask each student to quietly list each example seen.

Developing the lesson:

1. Make a list of all energy waste in the school.
2. Devise a method to eliminate each example of waste listed.
3. Present the list to your principal and/or custodian.

Extending the lesson:

1. Create a poem, picture, dance, song or whatever, to reveal your feelings about energy waste.
2. Describe the values you hold which cause your "feelings."
3. Survey students' feelings about the "energy crisis."
4. Organize an "Energy Awareness Week" at your school.
5. Create a TV commercial promoting energy conservation in the community.
6. Convert your TV commercial to poster "ads."
7. Use your "ad" to change energy use in your classroom, school, or home.
8. Prove that your posters caused a change in energy waste.
9. Design a sign, without words, to urge public energy conservation.
10. Design awards -- "ENERWARDS" -- for people who conserve energy.
11. Do the same for businesses, clubs, etc.
12. Add to the class energy word list.

GRADE SEVEN

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Title: Where Has All The Fuel Gone?

Concept: Energy is the ability to do work.

Objective: To discover the relationship between energy and work

Introducing the lesson:

1. Ask: How many of your parents have had difficulty getting gasoline for their cars?

2. Make a list of the class members and the occasions when their parents were unable to get gasoline.

Developing the lesson:

1. Have the students keep a record for a week of all the gasoline stations that have lines of cars; closed days; "out-of-gas" signs, etc.

2. Do a similar survey to locate closed stations and the brand name of the gasoline they formerly sold.

3. Ask: What kinds of stations seem to be most affected by the gasoline shortages?

4. When your parents get gasoline, survey the station owners to find out:

   a. where does their gasoline come from?
   b. how much do they get each month? (their allocation)
   c. who decides this amount?
   d. how does their allocation compare with the year before?
   e. do they own their station or operate it for an oil company?
   f. would they favor some kind of a rationing plan?

Extending the lesson:

1. Draw a picture of you and your parents waiting in a line to get gasoline for your car.

2. Ask: How do the values of people affect their behavior in the gasoline station line? (Are they patient, rude, greedy, thankful to be getting gasoline, other?)

3. Draw a picture which would illustrate your lifestyle if gasoline use was limited to getting to work and shopping.

4. Discuss your picture and compare it with those of other members of the class.

5. Ask: Were your pictures realistic?

6. Ask: How would your new lifestyle affect you and your community in terms of:

   a. community activities?
   b. shopping?
   c. recreation?
   d. out-of-community activities?
   e. other energy uses?

7. Start a class word list of energy terms - an energy vocabulary.

GRADE 7, UNIT I, LESSON 2

Title: Energy And Matter

Concept: Energy is held in various forms of matter.

Objective: To discover the relationship between energy and matter

Introducing the lesson:

1. Hold up a nut, a candy bar, a battery, a candle, a piece of wood or coal, a balloon full of air.

2. Ask: What do all of these things have in common? (All contain stored energy in various forms.)

Developing the lesson:

1. Ask: What are the three forms of matter in which energy can be stored? (solid, liquid, gas)

2. Ask the students to give some examples of each. (coal, gasoline, natural gas)

3. Ask: What do we call these forms of matter which contain stored energy? (fuels)

4. For each of the items used to introduce the lesson, investigate how the energy in it can be used. (Let the balloon go and the escaping air will move it; pass electricity through the battery; burn the candle, wood, or coal; eat the candy bar and nut.)

Extending the lesson:

1. Ask: What kinds of matter contain energy which cannot be released or used by burning or passing electricity through it? (radioactive matter such as uranium ores which radiate their energy into the environment)

2. Ask: What kinds of matter do not contain energy? (inert matter - gases, and minerals which are not radioactive)

3. Draw a picture of yourself enjoying your favorite form of matter containing energy.

4. Describe your picture in any way except with words.

5. Investigate the amount of energy in different forms of matter. (calorie chart)

6. Make up a calorie chart for the items shown by the class in their pictures of favorite forms of matter.

7. Add to the class energy vocabulary.

GRADE 7, UNIT I, LESSON 3

Title: Move Like Something

Concept: Energy is required to make something move.

Objective: To discover the relationship between energy and movement

Introducing the lesson:

1. Take the class to the auditorium or gymnasium.

2. Ask each student to decide on their favorite use of energy and to design a movement which shows this use of energy. (Be ready to provide music.)

Developing the lesson:

1. Ask for volunteers to demonstrate their favorite use of energy for movement.

2. Have the class decide what use of energy each movement illustrates.

3. Some students will need encouragement. Ask: How many have designed a movement similar to (a name)'s?

4. Ask: Who designed a different movement from any we have seen?

5. Ask: Is there anyone else? (Some students still may not want to perform. Perhaps they could show the class in a different way.)

Extending the lesson:

1. Gather the students who designed similar movements and have them develop a dance which includes all the movements used by the members of the group. (for example, a football dance; a dance dance; a birdwatcher's dance)

2. Compare the movements used in terms of the amount of energy used to do them.

3. Devise a system for measuring energy use without measuring. (getting tired, sweating, faster breathing)

4. Ask: Why would these devices indicate greater use of energy? (breathed faster to get more oxygen to release energy; sweat indicates excess heat produced)

5. Ask: Could you do a movement which would not require any use of energy? (no)

6. Ask: Are we using energy when we are doing nothing? (yes - staying alive, warm, in good health, organs functioning, etc.)

7. Ask: Can we do nothing? (When we do nothing, we will no longer be alive. Energy is needed for any body action or function, even those we cannot control.)

8. Add to the class energy vocabulary.

Title: What's In A Barrel Of Oil?

Concept: Energy comes in many forms.

Objective: To discover the relationship between energy and fuels

Introducing the lesson:

1. Ask: Is diesel fuel the answer to the nation's gasoline shortage? (Evidently not, as we shall see, even though diesel fuel is usually cheaper and diesel engines are more energy efficient in terms of mileage per gallon and maintenance.)

2. Examine and discuss the diagram which shows what our oil refineries get from a barrel of crude oil. (next page)

Developing the lesson:

1. Compare the amount of gasoline obtained with the amount of distillates. (43% to 22%)

2. Ask: What other factors influence the amount of diesel fuel available for automobiles? (Heating oil is also made from distillates and is used in homes and factories; when more heating oil is needed, there will be less diesel fuel.)

3. Ask: What factors influence the amount of diesel fuel available for diesel automobiles? (Diesel is also used by trucks, trains, and farm equipment, all of which will have priority over automobiles in the event of a shortage.)

4. Investigate the other products that are made from oil.

5. Ask: What is "Miscellaneous?" (jet fuel, kerosene, asphalt, lubricants)

6. Petrochemicals use about 4% of our crude oil. Investigate the use of petrochemicals in making fertilizer, plastics, and fibers.

7. Ask the students to survey a shopping center and list the products for sale there. Discuss what the stores would have to sell if oil was no longer available for synthetic materials.

Extending the lesson:

1. Describe your life without plastics or synthetic fibers.

2. Ask the students to determine their priorities for use of:

   a. crude oil
   b. gasoline
   c. distillates

3. Investigate how the students' priorities compare with the priorities established by state and federal governments. (For example, the federal government has given priority to farm production.)

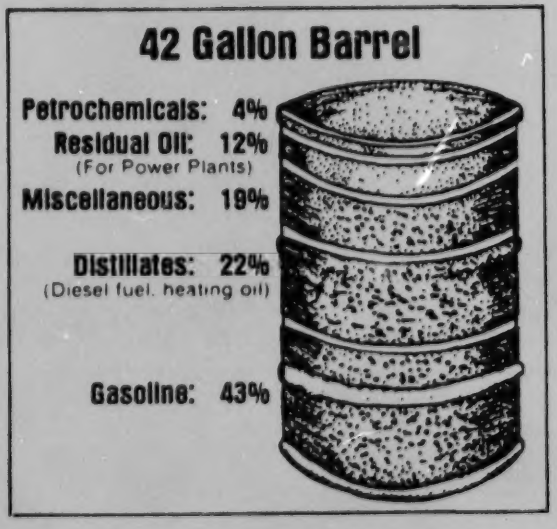
4. Investigate the reaction of truckers to shortages and costs of diesel fuel.

5. Ask: Is diesel fuel the answer to the problems of the automobile owner?

6. Ask: If electric power plants use only residual (left over) fuel, why convert them to coal? (In the future, refineries will have to use every drop of crude; there will be no "residuals" to use.)

7. Ask: Is the news that we can have either gasoline or heating oil somewhat misleading? Discuss. (Remember that the diagram barrel used in this lesson is meant to show what we now get from a barrel of crude oil. If necessary, refineries could get all heating oil or all petrochemicals, etc.)

8. Add to the class energy vocabulary.



Title: Hydrogen As A Fuel

Concept: Energy comes in many forms.

Objective: To discover the relationship between energy and fuels

Introducing the lesson:

1. In his book, THE MOVING AMERICAN, author George W. Pierson wrote: "One of the essential freedoms of American Democracy is the freedom to move." He believes that the famous dictum of Descartes: "I think, therefore, I am," has been changed in American philosophy to: "I move, therefore, I am alive." Ask the students to comment on this statement.

2. Scientists say that the energy to move us about, as well as to produce our electricity, could be obtained by using hydrogen as a fuel. Ask: How can we get hydrogen?

Developing the lesson:

1. Investigate the use of wind power to produce hydrogen.

2. Investigate the use of hydrogen as a fuel in internal combustion engines. (see Wilson Clark reference)

3. Ask: Why are so many people afraid of hydrogen? (The explosion and burning of the German dirigible Hindenburg at Lakehurst, New Jersey, over 40 years ago is still remembered when hydrogen is discussed as a fuel.)

4. Ask: Are the fears of hydrogen valid? (Hydrogen can be dangerous, as is any fuel gas, forming an explosive mixture with air, burning easily, with intense heat. That is why it is a good fuel! However, hydrogen is so light that it diffuses rapidly into the air after a leak or spill, and actually poses less of a hazard than gasoline.)

5. Investigate other methods of producing hydrogen using electricity. (by power plants during "off-peak" hours; by ocean thermal temperature differences, as in the Gulf Stream, etc.)

Extending the lesson:

1. Ask: What about air pollution from use of hydrogen as a fuel? (Hydrogen combines with oxygen in burning, producing only water as its waste; the only pollutant in automobile engines would be small amounts of nitrogen oxides.)

2. Investigate the use of hydrogen to produce electricity locally in fuel cells. (see Clark reference)

3. Read in Jules Verne's famous 1847 novel, THE MYSTERIOUS ISLAND, about an engineer who predicted the use of hydrogen as a fuel when coal and other fuels are all gone.

4. Investigate other potential synthetic substitutes for petroleum products as fuels. (acetylene, ammonia, hydrazine, methane and methanol)

5. Discuss other ways in which hydrogen can be used by people to conserve scarce oil supplies.

6. Discuss the interest of the oil and power companies in the use of hydrogen as a fuel.

7. Compare this interest with that of an environmentalist.

8. Add to the class energy vocabulary.

Title: Nature Stores Energy

Concept: Energy comes in many forms.

Objective: To discover the relationship between energy and the fuels and foods produced by plants

Introducing the lesson:

1. Ask: What is the most important chemical reaction on earth? (the reaction in which the radiant energy of the sun is absorbed by the chlorophyll in a green plant, producing the chemical energy which sustains life on the earth)

2. Review the process of photosynthesis. (Photosynthesis breaks down the water and carbon dioxide taken in by a green plant to form sugar - a composite of carbon, hyrdogen, and oxygen - and pure oxygen, thus capturing the sun's energy and storing it.)

Developing the lesson:

1. Investigate the storage of energy in carbohydrates and ATP (adenosine triphosphate) in living cells.

2. Ask: How do animals use this stored energy? (to do muscular work, keep warm, to generate nerve impusles, to make proteins and other molecules for building new cells)

3. Review the kinds of plant foods we eat and determine the plant part which stores it. (Obviously, the part which stores most of the energy is the part we eat.)

4. Ask: Are there any plant parts that are not used for the storage of energy? (No, they will all burn.)

Extending the lesson:

1. Investigate the relationship between energy storage and size of seeds in a plant. (Plants that store their food in stems or roots have tiny seeds compared to corn or beans, which store their food in seeds.)

2. Design a dream plant which stores food in every part.

3. Ask: Which part of your dream plant would you prefer to eat? How would you decide?

4. Ask: What energy stored in plants is not available as food to people? (Cellulose: humans do not have the digestive enzymes necessary to break down the cellulose in wood, grass, cotton, seed coats, etc.)

5. Add to the class energy vocabulary list.

Title: Burning

Concept: Energy is released from matter by burning.

Objective: To discover the relationship between energy and matter

Introducing the lesson:

1. Ask the students to list all the kinds of burning they can. (fire; sensation of the skin in the wind; giving light, as a candle; injury caused by heat, extreme cold, chemicals, electricity, or lightning; burning of food in an animal body)

2. Ask: What do all the examples have in common? (burning - the combination of an organic substance with oxygen or oxidation)

Developing the lesson:

1. Draw pictures or a diagram to show the oxidation of fuels to produce heat.

2. Design a demonstration to show that energy can be changed from one form to another.

3. Have the students combine two or more of their demonstrations to show a new energy change.

4. Show how people use energy changes.

5. Demonstrate how matter could be either a food or a fuel.

6. Give some examples of matter that are food for one kind of animal and fuel for another animal.

Extending the lesson:

1. Invent a device to measure heat given off by burning.

2. Measure some heat with your device.

3. For each fuel or food conversion to energy by burning, list the by-products formed.

4. Create a way to show how heat and joy are interrelated.

5. Show this relationship in a drawing.

6. Go on to the next lesson to learn one of the possible effects of burning fuels by people.

7. Add to the class energy vocabulary.

Title: "Greenhouse Effect"

Concept: Energy can be changed from one form to another.

Objective: To discover the relationship between different forms of energy

Introducing the lesson:

1. Ask the class to list the possible effects of increased burning of fuels on the earth environment. (addition of heat, increased carbon dioxide, air pollution, etc.)

2. Investigate the operation of a greenhouse. (Glass lets in solar short-wave radiation, but prevents the passage of long-wave infra-red radiation - heat - out of the greenhouse. A closed automobile sitting in the Florida sun is another good example.)

Developing the lesson:

1. Scientists know that carbon dioxide acts in the atmosphere like the glass in a greenhouse, keeping in the heat from solar radiation. Ask: What effect could this have on the earth's climate? (raise the temperature)

2. Ask: How could the increased burning of fuels contribute to the "greenhouse effect"? (an increase of both heat and the carbon dioxide which holds it on earth)

3. Construct model greenhouses and measure the effect on inside air temperatures after exposure to the sun.

4. Measure the increase in temperature in a school bus or automobile sitting in the sun for one hour; two hours; all morning.

5. Investigate the predictions of scientists regarding the effects of the heat which will be released in the burning of the earth's remaining fossil fuels. (Some estimate a 2 degree Fahrenheit increase in the earth's temperature. Other scientists believe that the earth may grow colder as a result of the large amounts of smoke, soot, etc. released into the atmosphere, which may reflect sunlight away from the earth, thus cooling the planet.)

Extending the lesson:

1. If the earth's temperature raises 2 degrees Fahrenheit, scientists estimate that melting of the Antarctic ice-cap would raise the level of the oceans (sea level) by 200 feet. Draw a map of the "new" United States, showing areas under 200 feet covered with water. (without its coastal cities - and Florida)

2. Discuss other possible effects of increased energy use:

   a. transportation of oil (oil spills)

   b. automobiles (air pollution)

   c. urbanization (loss of vegetation - carbon dioxide sink)

   d. agriculture (loss of forests - carbon dioxide sinks)

3. Investigate plans to utilize the increased "waste" heat for power production.

4. Add to the class energy vocabulary list.

Title: Move Molecules

Concept: Energy can be changed from one form to another.

Objective: To discover the relationship between energy and the movement of molecules

Introducing the lesson:

1. Ask the students to cover their eyes while you:
   a. spray a perfumed aerosol.
   b. peel an orange.
   c. release some favorite odor.
2. Ask them to identify the odors.
3. Ask: How did the smells get from the front of the room to your nose? (Molecules moved in the air.)

Developing the lesson:

1. Ask the students to design a demonstration (or use one which occurs in the community) to demonstrate how molecules move in:
   a. water (boil it)
   b. in honey or catsup (pour it)
   c. a fluorescent tube (light it)
   d. a wire (bend it back and forth, or send electricity through it)
   e. an iron nail (magnetize it)
   f. ice (put an ice cube in water)
2. Ask: What happened in each case? (Matter was heated.)
3. Investigate how people change molecules from one form to another in:
   a. liquified natural gas.
   b. gasification of coal to natural gas. (synthetic gas)
   c. liquefaction of coal to oil.
   d. getting oil from shale or tar sands.

4. Ask: How do these processes make it easier to move fuels from one place to another? (Gas is compressed; oils easier to move after rock, sand, and impurities are removed.)

5. Consider the environmental effects of each of the fuel conversion processes.

Extending the lesson:

1. Describe an environment in which all fuels were first converted to clean-burning gas. (Remember the great amounts of water needed for conversion processes.)

2. Ask: What problems would still exist in the "clean gas" world? (increased carbon dioxide; environmental damage in coal and shale mining, etc.)

3. Relate the kinds of energy used in our community to its transportation, storage, and utilization.

4. Visit an airport and investigate the kinds of fuels used by various aircraft.

5. Investigate the environmental problems of unwanted molecules in energy use:

   a. sulphur in coal, oil, and gas (acid rain)

   b. nuclear radiation

   c. heat pollution (power plant cooling waters)

   d. waste disposal

   e. auto emissions

6. Discuss how these and other energy problems have become political issues.

7. Add to the class energy vocabularly.

Title: Man And The Sun

Concept: Radiant energy comes from the sun.

Objective: To discover the relationship between the energy of the sun and life on earth

Introducing the lesson:

1. Ask the students to complete the following phrase: "Solar radiation is....." (Consider its nature, appearance, effects, capture by plants, use by animals and man.)

2. Discuss the student responses and make a list of possible topics for further discussion and investigation.

Developing the lesson:

1. Follow up on ideas for activities from the discussion above.

2. Investigate the solar architecture of the Pueblo Indians; design for heating, cooling, ventilation, illumination, and integration with natural cycles of season and climate.

3. Ask: How does this solar architecture correspond to animal structures - bee hives, ant hills, animal burrows, bird's nests, etc.?

4. Ask: Why has modern man lost the art of solar architecture in the high energy society? (Air conditioning has replaced mental skills and ingenuity in dealing with nature.)

Extending the lesson:

1. Investigate the suggestions for siting and orientation of houses, buildings, and even cities with regard to the sun, prevailing winds, and other climatic and geographic features by the ancient Roman architect Vitruvious in the time of the Emperior Augustus. (see Wilson Clark)

2. Investigate the design and construction of the buildings of the Seminole and Miccosukee Indians of Florida.

3. Ask: Why were early American barns painted red? ("Paint" was skim milk mixed with iron rust coloring and lime, which absorbed sunligth - a "solar heating device.")

4. Predict the future for buildings like the World Trade Center Twin Towers, with over 100 stories, and no insulation or windows that will open. Discuss how a building like this could have been designed and constructed. (Energy was so cheap; there was no reason to be concerned about the costs of heating, cooling, or lighting.)

5. Investigate modern solar architecture in the U.S.A. to determine how it is like - or unlike - ancient solar architecture.

6. Add to the class energy vocabulary list.

GRADE 7, UNIT IV, LESSON 2

Title: A Clothes "Pole"

Concept: Solar energy is used to evaporate water.

Objective: To discover the relationship between energy and the evaporation of water

Introducing the lesson:

1. Survey the class to determine use of appliances for washing and drying clothes. Ask: How many of you are wearing clothes that were washed and dried without using any appliances?

2. Determine what articles of clothing are most apt to be washed by hand and hung up to dry.

3. Now make a separate survey for washing and drying.

Developing the lesson:

1. Ask: How many have an outdoor clothesline or dryer?

2. The U.S. Department of Energy estimates that the average owner of a clothes dryer uses 1000 kilowatt-hours of electric power per year. Calculate how many kilowatt-hours of electric power are used by the homes of class members, using the DOE's average rate.

3. How much would this cost at 6¢ per kilowatt-hour? 8¢ per kilowatt-hour?

4. From local weather records, determine the number of days on which clothes could have been dried outdoors in your community last year.

5. How much energy could be saved if all the people in your community hung their clothes out to dry? (Multiply number of homes times 1000 kilowatt-hours per year.)

6. Conduct a "clothes pole" (poll) of your neighborhood to find out how many homes have dryers and how many have outdoor clotheslines.

7. Ask: Is there any evidence that the number of outside clotheslines is changing?

Extending the lesson:

1. Survey radio and TV advertisements for detergents. How many emphasize the "clean, fresh smell of the outdoors" which is lost by using an electric or gas dryer?

2. Investigate why Monday was always washday.

3. Discuss the relationship between the increase in use of clothes dryers, air pollution, and urbanization.

4. Investigate the water pollution problems associated with the use of detergents.

5. Ask: Should the use of clothes dryers be banned to save electricity or gas? Discuss the pros and cons.

6. Ask: Is there another appliance that your family would rather give up than your clothes dryer?

7. List the appliances in the order in which the members of the class would give them up in the event of serious energy shortage.

8. Add to the class energy vocabulary list.

Title: Moving Air

Concept: The sun's energy affects the atmosphere of the earth.

Objective: To discover the relationship between solar energy and moving air

Introducing the lesson:

1. Complete the following sentence: "Wind is....."
2. Write the words used by the students on the chalkboard as fast as you can, no matter how unlikely they may sound to you.
3. From the class list of words, develop a list of opposite words which can be used to describe moving air. (for example, hot-cold; good-bad; fickle-steady; reliable-unpredictable; gentle-violent; etc.)

Developing the lesson:

1. Ask: What do most of the words tell us about what wind is? (moving air)
2. Investigate the atmosphere around the earth as a giant heat machine (engine) moved by solar radiation. (The rays of the sun, stronger near the Equator than in the polar regions, cause tropical air to warm and rise, while cooler polar air moves in to replace it.)
3. Discuss the effect of the earth's rotation on this north-south flow of heated air. (air moving to the north - a south wind - is deflected toward the east = a SW wind; air moving to the south - a north wind - is deflected toward the west = a NE (trade) wind)
4. Ask: What other factors influence the movement of air? (local atmospheric conditions - high and low pressure systems; obstructions - mountains or high buildings; and type of surface - asphalt, land, or water, which influence local heating and cooling)
5. Discuss how a sea breeze follows this general pattern of uneven heating of the earth's surface. (Air over land heats and rises; colder air over water flows in to take its place.)

Extending the lesson:

1. Investigate the historical importance of the wind as a source of energy for people's use. (moved ships; pumped water; milled grain; etc.)

2. Investigate the windmills invented by Marcellus Jacobs of Fort Myers, Florida, to produce electricity with a wind generator.

3. Move like the kind of wind which represents each of the words used to describe it at the beginning of this lesson.

4. Draw a picture of your favorite wind, and a wind you are afraid of.

5. Ask: How do airplanes use the wind? (take-off; landing; flight; jet stream; tail winds)

6. Investigate how wind and other weather records are kept.

7. See the wind graphically on the TV satellite weather report each day.

8. Add to the class energy vocabulary list.

Title: Who Needs Appliances?

Concept: People use energy to do their work.

Objective: To discover the relationship between people's use of energy and the appliances that do their work

Introducing the work:

1. Ask: Who needs appliances?

2. Make a class survey to develop a list of appliances that are used by your students.

3. Rank the appliances on the class list according to the number of students who use them.

Developing the lesson:

1. Have the students rank the class appliances in order of most importance to them in their daily lives.

2. Determine what, if any, appliances the students would be willing to give up in an electricity "crisis."

3. Investigate the contribution of George Simon Ohm (Ohm's Law) to man's application of electricity to the needs of civilization. (Discovered the relationship between the resistance to the flow of electricity in a wire and its transformation into heat and light, as in an electric toaster or heater.)

4. Ask: How did Thomas Edison use Ohm's Law to develop the electric light bulb?

5. Trace the influence of man's use of appliances on:

   a. industry
   b. social concentration
   c. education
   d. power distribution
   e. lifestyles
   f. recreation
   g. entertainment
   h. others you can think of.

6. Find advertistements promoting greater use of appliances.

7. Look for changes in industry ads as a result of the energy crisis.

Extending the lesson:

1. Write a rebuttal for the appliance ads you found.
2. Perform the part of a salesperson representing an energy-conscious appliance company.
3. Draw a picture of yourself in a world without appliances.
4. Describe your new world.
5. Write a paragraph describing your last weekend, leaving a blank each time you would write an energy word.
6. Keep a record of each electric appliance you use during a week and what you used the appliance for. (for example, toaster - toast bread)
7. Compare your week's use of appliances with a list for someone from another culture or period. (pioneer, Indian)
8. Examine the effect of the development of an appliance on an industry. Try to find an industry for each kind of appliance on the class list. (for example, the effect of the toaster on the bread industry; or washer-dryer on laundromat)
9. Ask: Who needs appliances?
10. Add to the class energy vocabulary list.

Title: Synthetics

Concept: People use oil to produce synthetic materials.

Objective: To discover the relationship between synthetic materials and the oil chemicals and energy used to make them

Introducing the lesson:

1. Ask: If you took off all the clothes you are wearing that were made from synthetic materials or fibers, what would you be wearing? (possibly not much more than part of a pair of sneakers and a smile)

2. Make a class list of the synthetics being worn.

3. Ask: Do we live in an age of synthetics?

Developing the lesson:

1. Investigate the use of crude oil by the petro-chemical industry. (use about 5% of oil supply to produce the chemicals needed for the manufacture of synthetics)

2. Take a class field trip to a shopping mall to survey the store windows for synthetic products. (Do not go into any of the stores.)

3. At the end of the field trip, make a list of the synthetic products seen by members of the class.

4. Divide the class list of synthetic products into the following categories, those which:

   a. make life easier

   b. make life more comfortable

   c. make life more enjoyable

   d. make life more wasteful

   e. make life more efficient.

5. Determine how many stores would have things to sell if there were no synthetic products.

6. Investigate the substitutes for these and other natural products--wood, leather, cotton, wool, oil.

Extending the lesson:

1. Check your own list of synthetic possessions.

2. Discuss how synthetic products have changed the form and amount of packaging by industries. (Use the yellow pages to get a list of industries affected.)

3. Discuss the pros and cons of modern packaging.

4. For each item on the class list of synthetic products, determine the natural materials that were replaced and the effects on the industries that market the natural materials. (effect of nylon on cotton, for example)

5. Synthetics have replaced natural materials in many manufacturing processes. Investigate the effects of this replacement on people and sections of the nation. (for example, effect on the South of changes in textile manufacturing)

6. Make a mural showing life before the invention of synthetic products.

7. Devise a synthetics-energy conservation program for:

   a. yourself

   b. your school

   c. your home

   d. your community.

8. Ask: Should we save the 5% of crude oil used by the petrochemical industry? (Consider your discussion in relation to the number of stores dependent on synthetics.)

9. Add to the class energy vocabulary list.

Title: Gasoline Rationing - Why Not?

Concept: People need energy for transportation and commerce.

Objective: To discover the relationship between the lives of people and their use of energy

Introducing the lesson:

1. Presidents, governors, and legislators and government officials at every level keep saying there will be no rationing of gasoline....it doesn't work...it isn't fair...it would cost too much to develop and operate a rationing plan...etc. Ask: Why not have a rationing plan for gasoline if supplies are as limited as our officials say?

2. Collect stories and pictures of lines of cars at gasoline stations.

3. Write a newspaper article about lines at gasoline stations and reactions of people waiting.

Developing the lesson:

1. Survey gasoline supplies in your community and how they compare with supplies available a year ago.

2. Investigate previous attempts to ration gasoline. (World War II, and in 1979)

3. Interview someone who can remember rationing during World War II.

4. Discuss the elements of various rationing plans.

5. Describe the effects of a rationing plan under which each licensed driver received coupons which could be used or sold; used but not transferable.

6. Using all possible elements, devise a rationing plan on which the class could agree. (probably impossible, which will be a good illustration of why politicians do not want to be involved in developing a plan)

7. On the basis of your discussion, ask if the students think any plan could be entirely fair.

8. Evaluate the odd-even license number system of selling gasoline used in California, Florida, and other states during the last gasoline shortage.

9. Investigate modifications in the odd-even plan.

10. Ask: What is a "black market?"

Extending the lesson:

1. Ask: How about closing gasoline stations on weekends?

2. Investigate the effects of gasoline rationing on the tourist industry and the economy of Florida.

3. Discuss whether Florida as a tourist state should get a large allotment in any national allocation plan.

4. Calculate the amount of gasoline needed to keep all the automobiles in the U.S. with full tanks of gasoline. (There are 110 million in the U.S.; 5 million in Florida. Tanks hold from 15-25 gallons.) Compare this amount with the normal amount of gasoline in the gas tanks of America's automobiles. (about double, since normaily tanks average about half full, with some full, some nearly empty, some in between)

5. Ask: During the last energy shortage, how did the media (radio and TV) contribute to the shortage? (scared people into keeping tanks full)

6. Write a paper describing how your lifestyle would be affected during a period of gasoline rationing or shortage.

7. Investigate the dangers of carrying gasoline in cans in the trunks of automobiles.

8. Devise a system to beat the rationing plan the class developed.

9. Add to the class energy vocabulary list.

Title: Obituary To A "Gas Guzzler"

Concept: Energy supplies are limited.

Objective: To discover the relationship between energy supplies and automobile engine efficiency

Introducing the lesson:

1. Read this to your class: A television news story stated that an association of owners of Rolls-Royce automobiles is lobbying for special consideration for their gasoline needs in the event of a gasoline shortage. Their reason: they are unique, and their 5 mile-per-gallon "gas guzzlers" are an important element of the good life of American and should be maintained. The owners also expressed their willingness to pay a penalty tax of $500 to $1000 to offset their high use of energy.

Developing the lesson:

1. Ask: Do you think the large, luxury car owners have a valid argument?
2. Discuss the pros and cons of their case.
3. Ask: Do you believe a penalty of $500-$1000 would make up for their excesive use of gasoline? (Their cars cost up to $75,000.)
4. Check with your local big-car dealers to determine any changes in their automobiles since the oil crisis of 1973 in:
   a. weight of automobiles
   b. gasoline efficiency in miles-per-gallon
   c. sales volume
   d. advertising (efficiency vs. luxury).
5. Survey small car dealers to determine any change in the number of big-car owners who have traded in their "gas guzzlers" for a small automobile.
6. Investigate the availability of diesel engine automobiles.
7. Write an obituary to a "gas guzzler."

Extending the lesson:

1. Design an epitaph to a "gas guzzler."
2. Ask: What will take the place of the large luxury car in the dreams of people?

Title: Energy Ads

Concept: People make demands on limited energy supplies.

Objective: To discover the relationship between energy shortage and advertisements for business products

Introducing the lesson:

1. Collect energy industry advertisements from newspapers and magazines and discuss their messages to the public.

2. Classify the advertising into categories. (price rise justification; "what a good job of conservation we're doing"; cost of regulation; "survival" ads arguing against divestiture of competing energy sources; etc.)

Developing the lesson:

1. Discuss the validity of each of the categories of advertisements you collected.

2. Ask: Are the arguments of the energy companies persuasive?

3. Look for ads that "turn you off"; "turn you on."

4. Discuss the reasons for the "turn off" or "turn on."

5. Collect ads from other businesses or industries that contain an energy message. (low mileage cars, etc.)

6. Look for ads which indicate a change in approach because of the energy shortage. (large cars emphasizing mileage and smaller size instead of luxury, etc.)

7. Ask: Why would an electric power advertisement call for conservation and decreased use of electricity? (Power companies can no longer meet the unlimited demands of people for electricity.)

8. Create a "billboard" advertisement for your school which stresses conservation of electricity.

Extending the lesson:

1. Design a cover for a new magazine to be called EN-ER-GEE.

2. Write an advertisement to appeal to new subscribers for your new magazine.

3. Design and produce a TV commercial.

4. Write a radio commercial.

5. Write the first energy editorial for EN-ER-GEE.

6. Write a "letter to the editor" of EN-ER-GEE supporting or criticizing the first editorial.

7. Divide the class into several editorial boards which will suggest topics for inclusion in the magazine.

8. Design the magazine on the basis of their recommendations.

9. Write an article for EN-ER-GEE which describes to your future son or daughter the present energy situation and what you are doing about it.

10. Illustrate your article.

11. Write your child's reaction to your letter.

12. Add to the class energy vocabulariy list.

Title: My Community Sees The "Crisis"

Concept: Limited energy affects the lives of people.

Objective: To discover the relationship between energy shortage and the life of a community

Introducing the lesson:

1. Ask: Who is to blame for the energy shortage?
2. Discuss the students' answers and the reasons for their opinions. (It will soon become obvious that there is no one answer. No one is to blame. Everyone is to blame. We are all, in some way, responsible. As Pogo says, "We have met the enemy and he is us.")

Developing the lesson:

1. Make a list of the people or events the students thought were to blame for the energy shortage. (President, Congress, Secretary of Energy, Iranian revolution, Mid-East situation, increasing population, limits to oil supply, greedy people, wasteful useage, too many cars, etc.)
2. Investigate each of the items on the list.
3. Ask: Why is it so difficult to get a national energy policy? (Most people do not really believe there is an energy shortage; many diverse groups and interests to satisfy; too politically dangerous.)
4. Survey community reaction to the energy "crisis". Ask:
   a. Is there an energy "crisis"?
   b. Do you have a personal commitment to energy conservation?
   c. What should government be doing about the energy shortage?
   d. Who is to blame for the energy shortage?

Extending the lesson:

1. Plan an energy conservation program for your:
   a. classroom
   b. school
   c. home
   d. community.

2. Make posters for your program.

3. Develop a slide or an other media production to illustrate your program's development and progress.

4. Start a personal energy conservation program.

5. Describe your personal program to the class. Include:

   a. a list of energy wasters you own or use

   b. how you decided

   c. which ones you don't really need to use

   d. how you can do without the ones you really don't need

   e. ways you can cut down on your use of the energy wasters.

6. Create a design for an energy T-shirt.

7. Make up some energy conservation slogans.

8. Collect bumper stickers with energy slogans.

9. Add to the class energy vocabularly list.

Title: I Depend On Others

Concept: Living things are interdependent.

Objective: To discover the relationship between people in the supply and use of energy

Introducing the lesson:

1. Ask: What did you eat for breakfast today that you grew yourself? Make a list of the replies. (fruit, bacon, sausage, etc.)

2. Ask: What are you wearing that you made yourself? (Even a homemade dress is made from materials made by other people.) Make a list.

Developing the lesson:

1. Make a class list of food items eaten for breakfast.

2. Construct a food energy chain starting with each breakfast item and including all links back to the green plant which originally captured the sun's energy and stored it.

3. Now construct an energy chain which shows all the people and energy involved in getting the breakfast items from their place of origin to your tables.

4. Make a similar list of clothes and materials worn by the class. (dress - cotton; shirt - polyester; etc.)

5. Trace on a map the routes followed by these clothes or materials from their country (or state) of origin to Florida (or you).

6. Construct an energy chain which shows the use of energy in the various steps between the fiber and the clothes you are wearing. (Be sure to include origin, manufacture, packaging, transportation, marketing, etc.)

Extending the lesson:

1. Trace the routes followed by the energy materials used to make the clothing from their point of origin to you.

2. Show how you are dependent on organisms that lived long ago. (In addition to most of our fuels, synthetic materials and fibers are made from fossil fuel oil formed from the bodies of plants and animals that lived millions of years ago.)

3. Investigate sources and supplies of foods and fuels that are limited because of national and international politics.

4. Draw a picture of yourself eating your favorite breakfast while wearing your favorite garment.

5. Ask: Why is sugar added to so many breakfast foods? (provides additional calories; is heavier and cheaper than cereals and is subsidized)

6. Ask: How do you depend on others for your energy?

7. Ask: What others depend on you for their energy? (workers in supermarket, gas station, farm, etc.)

8. Ask: What responsibility do you have for continued supplies of food and fiber? (Energy saved makes more available.)

9. Add to the class energy vocabularly list.

Title: Population And Energy Supply

Concept: Increasing population affects the amount of energy available to each person.

Objective: To discover the relationship between energy supply and numbers of people

Introducing the lesson:

1. Take the class outside to a quiet area of the school grounds. With a ball of string, lay out a circle about 20 feet in diameter. Then use more string to divide the circle into eight smaller sections of different sizes. The circle now represents the earth divided into several nations of different sizes.

2. Place half of the students in the countries to represent the population. Be sure to have at least one small country with three people and one large country with only one.

3. Let the rest of the class stand around the circle.

4. Show the class a bag of dried beans, preferably small and dark so they are harder to see. Say: These beans represent all the fossil fuel in the world.

5. Scatter the beans (modules of energy) unevenly around the "earth." Be sure to put only a few beans in the smallest country and many beans in the largest country.

Developing the lesson:

1. To start the game, ask each person to pick up one energy module. (If you want the game to go faster, pick up two.)

2. Pick up one more energy module.

3. Add one person to each country to represent an increase in population.

4. Pick up another energy module.

5. Continue the search for energy modules, with an occasional addition to the population, until the whole class is in the circle.

6. When a population in a country cannot find any more energy modules, they must leave the circle.

7. Continue the game until only a few countries have energy modules left, or interest lags.

8. Ask: Which countries end up with energy?

Extending the lesson:

1. Ask the students to compare the game with the world situation.

2. Ask the students to compare the countries in the game with real nations. (Is the small nation like Japan?)

3. Discuss how the real world differs from the game. (In the real world, many resources are involved, not just oil, so an energy-poor nation may have another resource to trade for energy.)

4. Discuss the actions of the students in the game:

   a. What did they observe?

   b. Did people get anxious, greedy, selfish?

   c. Did people reach over borders?

   d. Did people share?

5. Ask: How do you account for these behaviors?

6. Investigate the following nations to determine: size; population; energy reserves; major resources to trade: Venezuela, Canada, U.S.A., Saudi Arabia, Iran, Nigeria, Japan, Mexico.

7. Discuss the effects of increasing world population and increasing demand for limited energy supplies. Consider:

   a. economic effects

   b. political effects

   c. effect on standard of living.

8. Add to the class energy vocabularly list.

Title: "Who - Me"?

Concept: Each individual has a responsibility to conserve energy.

Objective: To discover the relationship between the "energy crisis and me"

Introducing the lesson:

1. Ask: Are you part of the energy problem?
2. Ask: What have you done today to conserve our scarce energy supplies?
3. Make a list of the things students did to conserve energy during the past week.

Developing the lesson:

1. Ask the students who feel that they are not part of the energy problem to defend their position. Have a recorder keep a record of the discussion.
2. Ask the students to record for one week:
   a. number of times they opened the refrigerator
   b. asked their parents to drive them somewhere
   c. rode a bike instead of asking for a ride in a car
   d. drank a cold drink
   e. used ice cubes
   f. took a hot shower
   g. sat in an over-cooled room
   h. watched TV
   i. add another item.
3. Ask again: Are you part of the energy problem?

Extending the lesson:

1. Discuss how the energy shortage has changed the lives of members of the class and their families.
2. Investigate the effects on the school, the community, the state, the nation.

3. Discuss changes in the lifestyles of people and how they might be affected by continued energy shortages. (We will still live the "good life" even if we conserve energy.)

4. Compare lifestyles of people in the 1950's and today. (In the U.S., we used 50% less energy per person in the 1950's.)

5. Add to the class energy vocabularly list.

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Title: Solar Energy For Power

Concept: Energy is the ability to do work.

Objective: To discover the relationship between energy and power

Introducing the lesson:

1. The day before starting this lesson ask each student to bring in a small mirror and a magnifying glass.

2. Take the students outside to the school yard. Have them try to focus the rays of the sun on a small piece of paper placed on a sidewalk or other bare area. (Bring a small container of water to wet the area around the paper.) Students should have no trouble burning a hole in the paper. They have used solar energy to do work.

3. Next, set up a piece of paper vertically between the sun and the class. Ask the students to use their mirrors to focus the sun's rays on the piece of paper from their position. (They will have to move forward or back to do this.)

4. After they have focused their mirrors, have them try to focus on a central spot to burn a hole in the paper.

5. Have each student measure and record the distance from the mirror to the paper. (Are they all the same distance?)

Developing the lesson:

1. According to the Greek historian Galen, the Greek scientist Archimedes used solar reflecting mirrors (bronze shields) to set fire to the Roman fleet besieging the City of Syracuse in 212 B.C. by focusing the sun's rays on their black sails. On the basis of their own experience, do the students think this was possible?

2. Read about how this might have been done in the book, "Power For The People," by Allen and Marjorie Meinel.

3. Investigate the construction and operation of a solar oven.

4. Build one and use it.

5. Ask one of the students to investigate and report on the solar system engine built by the French scientist Augustin Mouchet in the 1860's.

6. Do the same for the work of the Swedish-American John Ericson in the development of solar engines.

7. Investigate the research of Frank Shuman in Pennsylvania and his development of the Sun Power Company in 1908.

8. Compare the operation of the Sun Furnace in the French Pyreness (Felix Trombe) to the experience with mirrors the students had at the beginning of this lesson.

9. Investigate the use of solar power for desalting water.

Extending the lesson:

1. Ask: How did the discovery of oil in Pennsylvania affect the development of solar power? (Oil was a much cheaper source of power, so research was almost halted until 1973.)

2. Ask: How have "the times" made water desalinization important? (water shortages and pollution)

3. Investigate how the solar power research of Dr. Robert Goddard led to his invention of the rocket engine.

4. Investigate the development of solar water heaters in Florida.

5. Design a solar still.

6. Use it to get a drink of water.

7. Draw a picture of yourself operating a solar still.

8. Start a class energy vocabulary list. (There is one in the back of this teacher's guide, but it will be better to develop your own as your lessons occur.)

Title: Stored Energy And Work

Concept: Energy is the ability to do work.

Objective: To discover the relationship between potential and kinetic energy in water power

Introducing the lesson:

1. On a rainy day, take the class outside the school. Find a gully or gutter (it does not have to be a big one) and have the students watch how the water carries particles of soil and debris as it flows.

2. Dam up the water channel, creating a reservoir behind the dam.

3. Note how the water in the reservoir continually tries to flow out, requiring additional dams around the edges of the reservoir.

4. When the reservoir is full, ask one of the students to make a tiny hole below the surface of the water in the dam. Watch what happens.

Developing the lesson:

1. Ask the students why the water poured through the broken dam. (Stored energy released to provide active - kinetic - energy of flowing water.)

2. Ask: Why is the stored energy in the reservoir of water called "potential" energy? (Potential means capable of action due to its position.)

3. Investigate the production of hydro-electric power by a release of stored water from a reservoir through a turbine generator.

4. Discuss the limitations on amounts of hydro-electric power available in the world. (Limited - potential reservoir sites like the Grand Canyon are protected by their location in National Parks or Monuments; all reservoirs will eventually fill with sediments carried by the river which has been dammed. Remember the soil particles and debris carried into the class "reservoir" at the beginning of the lesson.)

5. Investigate the double use of the potential energy of stored water in the "pumped storage" concept of hydro-electric power development. (During periods of low demand for power, electricity is used to pump water to a higher reservoir. Then, when added amounts of electricity are needed to meet demand, this water from the higher reservoir is released to flow down through turbine generators to produce more electricity.)

6. Investigate the renewed interest in an age-old source of power; the small dam for local power to run mills and generate electricity.

Extending the lesson:

1. Investigate other ways in which energy can be stored. (nuclear, geothermal, fossil fuel, wood, food)

2. Find an example of energy that cannot be stored. (electricity)

3. Investigate the problems of big dam reservoirs like Aswan, Egypt, in terms of changed environments.

4. Investigate environmental objections to big dams in the U.S. (cover prime farmland; cut off passage of migratory fish; possible earthquakes as a result of great weight of stored water; loss of wildlife habitat; loss of water through evaporation; flood threat of broken dam)

5. Investigate tragic floods in Idaho, West Virginia, and other places.

6. Add to the class energy word list.

Title: We Change Environments

Concept: Use of energy by people has changed the environment.

Objective: To discover the relationship between the use of energy and its effect on the environment

Introducing the lesson:

1. Go outside the school and ask the students to look for and list any changes in their environment as a result of people's use of energy.
2. Make a class list.
3. Divide the class list of changes into the following categories:
   a. search for energy
   b. energy supply to school, home or community
   c. energy use
   d. waste disposal.

Developing the lesson:

1. Find evidence of ways people change environments in each of the categories above.
2. Investigate the environmental effects of production of:
   a. coal (strip-mining, acid wastes)
   b. oil (drilling, spills, offshore platforms)
   c. electricity (air, water, thermal pollution)
   d. nuclear power (radiation, radioactive waste disposal, heat).
3. Investigate the environmental effects of the use of:
   a. coal (air pollution by sulfur oxides, acid rain, soot)
   b. oil (auto emissions, sulfur oxides)
   c. electricity (power lines)
   d. nuclear electric power (same as electricity).
4. Investigate the environmental problems of various energy supply sources:
   a. Alaskan North Slope (need pipeline for delivery)

b. North Sea (deep water, rough seas, weather)

c. Gulf of Mexico (relatively few - storms, spills)

d. Big Cypress (destruction of wilderness)

e. Appalachia (ravaged lands from strip mining)

f. Shale formations in western U.S. (water supply, waste disposal)

5. Predict the effect of these environmental problems on future energy supplies.

Extending the lesson:

1. Investigate laws and regulations which are designed to minimize the environmental effects of energy supply, use, and disposal of wastes.

2. Investigate the impact of the Three-Mile nuclear power plant accident in Pennsylvania on the future of nuclear power production.

3. Draw a picture of your community without power lines.

4. Discuss the reasons for the seeming reluctance of industry and government officials to exert a major effort to develop solar electric power. (Most power would be produced locally, not in giant plants.)

5. Add to the class energy vocabulary list.

Title: Electricity Is....

Concept: Electricity is a form of energy

Objective: To discover the relationship between electricity and the fuels used to produce it

Introducing the lesson:

1. Divide the class into groups of four students.

2. Give each group a large (4x6 foot) piece of butcher paper and an assortment of colored marking pens (or assign each group to a section of the chalkboard).

3. Ask each student to use a one-foot square corner of their group paper, and, without using words, show how they would complete the sentence: "Electricity is...."

Developing the lesson:

1. After the students have completed their "sentences", ask each group to discuss how they would finish the sentence: "Electricity could be ...." until they have agreed on what they would say. Then...

2. Working as a team, ask each group to illustrate their completed "could be" sentence using the center of their paper. They may use words this time, but only to supplement their illustration.

3. After each group presentation, allow the class to discuss the presentation or ask questions.

5. Find ideas that seem to appear in all the presentations.

6. Discuss the possibilities of realization of their predictions of what electricity could be.

7. List the major uses of electricity in your school and community and predict how each of these would be affected by a shortage of electric power.

Extending the lesson:

1. Write a paragraph describing how you finished the sentences on electricity.

2. Do the same exercise for coal, gas, wood, atomic power.

3. Trace the historical influence of electricity on:

   a. industry

   b. social concentration

   c. education

   d. power distribution

   e. recreation

   f. entertainment

   g. lifestyles of people.

4. Describe a world without electricity.

5. Draw a picture of what your life would be without electricity.

6. Describe your picture to the class.

7. Invent a form of power to replace electricity.

8. Write a paragraph describing a day in your life, leaving a blank each time you used an energy word.

9. Who had the most blanks? the least?

10. Add to the class energy word list.

Title: Wind Energy

Concept: Wind is a form of indirect solar energy.

Objective: To discover the relationshiop between the movement of air and the energy it produces

Introducing the lesson:

1. Before you do this lesson, you might want to review Lesson 3 in Unit I, Grade 7.

2. Ask the class if there is anyone who has experienced a hurricane or severe storm.

3. Ask them to describe the storms, emphasizing the force of the wind, the pressure it exerts, the work it can do.

4. Collect pictures and news accounts of hurricanes that have passed over Florida. Make a bulletin board display.

Developing the lesson:

1. Ask: What is the principal "fuel" for the earth's heat engine? (Water vapor in the atmosphere, holding latent energy which is transferred to the atmosphere when water is alternately evaporated and condensed in the water cycle. Wind is the most evident form of this energy.)

2. Investigate the classification of winds by the U.S. Weather Bureau.

3. Distinguish between energy winds and prevalent winds. (prevalent winds - common, up to five days a week, 5-15 miles per hour; energy winds - storm winds, average two days per week, 10-25 miles per hour; for example, the "Northeaster" or "Southwester")

4. Ask the students to investigate the direction and average speed of the prevailing and energy winds in their area.

5. Describe, or move like a: zephyr; breeze; blast; gust; gale; storm; tornado; hurricane.

6. Investigate the contribution of Sir Francis Beaufort to measuring wind speed.

7. Ask: What would be the most important characteristics to consider in deciding whether to set up a windmill in your area? (prevailing wind, regularity, best height)

8. Ask: Would our area be satisfactory? (Scientists say that winds needed for power production should fall between Beaufort force 3 and 6 (gentle to strong breeze); higher winds may be destructive.)

9. Investigate the use of sailing ships throughout history.

10. Investigate the use of wind to pump water throughout history.

11. Find out how "sails" made windmills more efficient.

Extending the lesson:

1. Investigate the renewed interest in wind power in the U.S.

2. Investigate the plans for the use of windmills for the production of electricity and hydrogen for fuel by Dr. William Heronomus of the University of Massachusetts.

3. Move like your favorite wind.

4. Describe the production of electricity by wind generators.

5. Design and construct a windmill.

6. Add to the class energy vocabulary list.

Title: Earth Heat

Concept: The core of the earth is a hot, molten mass.

Objective: To discover the relationship between the earth's heat and man's need for new energy sources

Introducing the lesson:

1. Ask: What is the earth like 40 miles below the surface on which we live? (dense, molten rock at temperatures as high as 3300 degrees Fahrenheit)

2. Ask: How can people use this heat energy as a source of energy at the surface? (Lava flows through cracks to surface - volcano. Hot gasses heat underground water to the boiling point causing hot springs and geysers.)

Developing the lesson:

1. Investigate the history of volcanos like Krakatoa, Mount Ranier, Kilauea Iki, Vesuvius, Popocatepetl, Mount St. Helens.

2. Ask: How can a volcanic mountain like Mount Erebus in Antarctica exist? (Earth's heat is near the surface, even in Antarctica; many volcanos are snow-capped.)

3. Trace home heating with water from hot springs in Iceland.

4. Investigate the use of geothermal energy in the U.S.

5. Describe the three forms of geothermal energy. (dry steam; wet steam and water; hot, dry rocks)

6. Show on a map the hot springs and geysers of the world.

7. Investigate the operation of a geothermal power plant.

Extending the lesson:

1. Trace the history of people's use of geothermal energy.

2. Investigate the environmental effects of the use of geothermal energy for power production. (blowouts of salt-laden water; sulphur dioxide air pollution; water pollution; unknown but suspected earthquake effects; excessive cost with present technology)

3. Show pictures of geysers and hot springs.

4. List the famous hot springs of the U.S.

5. Investigate political constraints against use of geothermal energy in the U.S. (Most of sources are on federal lands, many protected in National Parks; much controversy over federal and possible ownership by same companies that now control other power sources.)

6. Describe your feelings when you first saw a picture of the geyser "Old Faithful."

7. Take a vicarious field trip to Yellowstone National Park via picture and story.

8. Draw a picture showing your favorite scene there.

9. Ask: Why are hot springs supposed to have therapeutic value for those who bathe in them? (The same salts and other minerals in the waters that are a concern of people worried about water and air pollution have a therapeutic value for bathers.)

10. Add to the class energy word list.

Title: Energy On The Farm

Concept: People use energy to supply their food and fiber.

Objective: To discover the relationship between energy use and agricultural production

Introducing the lesson:

1. In the U.S. we now use six times more calories of energy to produce our food than the food contains. Compare the farm of 100 years ago with a modern farm in terms of energy use.

2. Collect pictures of past and present farming methods and compare the apparent use of energy.

Developing the lesson:

1. Ask: What is the major difference between a "small" farm and a modern "agri-business"? (Consider size, type, and variety of crops raised, use of machinery, etc.)

2. Ask: What is the major difference between agricultural methods of today and 100 years ago? (Oats and animals did work instead of gasoline and machinery; monoculture instead of crop variety; synthetic fertilizers instead of manure; irrigation; etc.)

3. Note the similarities between the small family farm and the farms of the past.

4. Investigate the effects of monoculture (one crop) on the use of energy. (requires more pesticides, fertilizers)

5. Ask: How has the need for pesticides increased with the practice of monoculture? (Whole fields of crops of only one kind provide a haven for the insects that live on that particular crop species, so they would multiply tremendously if not controlled with poisons.)

6. Farmers say that the cost of wheat is only a small part of the cost of bread. Ask: What makes the cost so high? (transportation, packaging, marketing - all high energy users)

Extending the lesson:

1. Draw a mural showing the development of agriculture in the U.S.

2. Discuss the effect on the U.S. economy of exporting farm crops which have been produced at great energy expense.

3. Investigate the farming practices of China. (use of human labor, manure, etc.)

4. Investigate the potential for competition between farmers, truckers, auto owners, and boat owners for scarce diesel fuel.

5. Add to the class energy word list.

Title: Lighting

Concept: Energy can be changed from one form to another.

Objective: To discover the relationship between electricity and lighting

Introducing the lesson:

1. List all the ways people have devised to light their dwellings and the places where they work.
2. Make a class list putting the items in their correct order in terms of their historical development.
3. Ask: What is light?

Developing the lesson:

1. Ask: What changes in society caused the increased demand for lighting? (reading; need to light factories)
2. Investigate the research of inventor Thomas Edison in the development of the incandescent light bulb.
3. Discuss the changes in people's lives as a result of Edison's invention of the incandescent light bulb. (work, sports, movies at night, reading, social concentration, etc.)
4. Edison called his development of the first electric generating and distribution plant his greatest achievement. Ask the class if they agree.
5. Discuss its effects on the world and its people.
6. Ask: Why was lighting essential for the development of the modern skyscraper building?
7. Lighting takes 2 percent of the electricity produced in Florida. Ask the students to suggest ways this total might be decreased.
8. Measure the light intensity in your building and compare it with the state standard for lighting schools. (70 foot candles)
9. Locate any over-lit areas.

Extending the lesson:

1. Investigate the use of coal gas and natural gas for street lamps in cities.

2. Plan a lighting conservation plan for your:

   a. school

   b. home

   c. community.

3. Rank the uses of lighting in your school according to their importance. (Is there a difference in values?)

4. Ask: Would you be willing to give up night athletic events in order to conserve energy?

5. Discuss the possible effects of such a measure on:

   a. you

   b. your school

   c. your community.

6. Make a poster or collage showing alternative sources of light. (other than electricity - candle, whale oil lamp, etc.)

7. Add to the class energy vocabulary list.

Title: Entropy

Concept: When energy is changed from one form to another, some energy is lost.

Objective: To discover the relationship between different forms of energy as they change

Introducing the lesson:

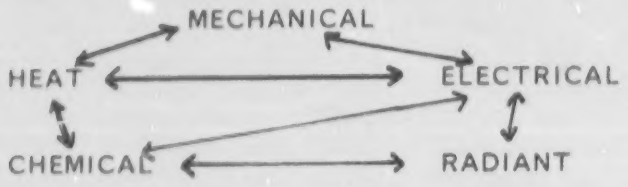
1. In 1859, the German physicist Rudolf Clausius described the 2nd Law of Thermodynamics as follows:

   "It is impossible for a self-acting machine, unaided by any external agency, to convert heat from one body to another at a higher temperature."

   Today the 2nd Law is known as the Law of Entropy. In modern terms: "we can't break even," since energy constantly flows from a higher to a lower level; or since energy constantly changes from a higher to a lower form. Ask: What is lost? (In any change of energy form, heat is lost.)

2. Put the following diagram on the chalkboard:

KINDS OF ENERGY CHANGES



3. Ask: What do the arrows represent? (changes from one form of energy to another)

Developing the lesson:

1. Give examples of each kind of change represented in the diagram. (A chemical reaction such as burning fuel can yield both heat and light. Heat, in turn, makes steam, and mechanical energy from a steam engine can be used to generate electricity. In each step, some heat is lost. At the same time, sunlight helps create electrical storms.)

2. Investigate Carnot's research with steam engines. Ask: What did he discover about heat and work? (Heat does work only when it flows from a warmer to a cooler place. The greater the difference in heat, the more work can be done.)

3. Ask: What happens to heat in automobile engines, tea kettles, smoke, warm air? (lost to atmosphere)

4. Find examples of people's efforts to get rid of excess heat of entropy. (cooling systems, car radiators, air-cooled engines, cooling towers in power plants)

5. Ask: How does friction affect movement of air, water, sliding child, tires on a road, etc.? (All are slowed down, and heat is produced and lost.)

6. Investigate how heat is lost in transmission of electricity. (poor insulators, wire resistance, bad splices, storm damage, transformer heating, generator friction)

Extending the lesson:

1. Investigate efforts to produce a perpetual motion machine which would defy the Law of Entropy.

2. Describe a dream machine of your own design.

3. Describe the world when all the heat has been lost. (Not possible as long as the sun continues to shine.)

4. Describe the effects of entropy in a food chain. (There is loss of energy at each step in the form of heat.)

5. Ask: Why would it be more efficient for people to eat vegetable matter than meat? (Animals use up and lose energy in making meat.)

6. Read Jeremy Rifkin's book "Entropy."

7. Add to the class energy word list.

Title: Brother Sun

Concept: Life on earth depends on the sun.

Objective: To discover the relationship between people and the sun throughout the ages

Introducing the lesson:

1. Read to the class the song to the sun written by St. Francis of Assisi in 1224:

   Praise to you, my Master, for all your creatures,
   Foremost for lordly Brother Sun
   Who lights our daytime for us.
   He is a beautiful thing who spreads forth a great splendor,
   Of You Most High, he is the visible emblem.

2. Ask: Why have people through the ages felt such strong emotions when they contemplated the wonders of the sun?

Developing the lesson:

1. Ask the students to comment on Henry Thoreau's comparison of daybreak and the rising of the sun with spiritual awakening.

2. Investigate how the culture of the Sioux Indians looked beyond the power of the sun to the responsibility of people to use it wisely.

3. Comment on how well we have heeded the advice of the Sioux.

4. Investigate the device known as the "Camera Obscura," the darkroom prototype of the camera.

5. Read the following passage from the Papago Indian ceremony to the sun:

   In the east is the house of the sun.
   Up over the top of his roof-beam
   The sun climbs and journeys
   Over the heads of us
   Who make our journey below him.
   I stretch my right hand sunward,
   Then trace upon my body
   The ritual sign.

   This ritual, called a "ciwiltkona" is performed by dancers who believe that they recharge themselves with the sun's energy as they circle a sand painting of the sun.

6. Write a new verse to the John Denver song "Sunshine."

7. Find two or more authors who have written about sun power and compare their descriptions of the sun.

8. Write a poem which expresses your feeling about the sun.

9. Investigate Inca worship of the sun.

10. Find pictures of the Inca temples to the sun "Father."

11. Find "Sun Fathers" in other cultures.

Extending the lesson:

1. Ask the students to describe the warm red pulse of the sun; its light reaching into them; their feelings as they watch its wonders of shore and sky.

2. Draw a picture of yourself enjoying the sun.

3. Describe your picture.

4. Set the words of the "sun songs" to music.

5. Add to the class energy vocabulary list.

Title: Heat Pumps

Concept: Heat can be transferred between the natural environment and the man-made environment.

Objective: To discover the relationships involved in heat transfer to and from the natural environment

Introducing the lesson:

1. Say: At last we have a device which seems to defy the laws of thermodynamics. It produces more energy as heat then is contained in the fuel used to operate it - the heat pump.

2. Ask: How could heat pumps benefit the energy conservation effort in the State of Florida?

3. Collect information on heat pumps for heating and air conditioning from local stores.

Developing the lesson:

1. Investigate the operation of a heat pump. (It operates on the same principle as a refrigerator - alternate evaportation and condensation of a heat transfer agent, freon, ammonia, etc., to take heat energy from a colder area - inside refrigerator - and pump it into a hotter area - kitchen. But unlike refrigerators, the heat pump can be reversed to provide heat instead of removing it.)

2. Investigate the heat given off by a refrigerator. Feel the coils under or behind the unit.

3. Ask: Is the heat given off by a refrigerator wasted? (It is not only wasted, but is released into a kitchen from which it may have to be removed by an air conditioner.)

4. Ask: What is the source of the heat required for the evaporation of the heat transfer agent? (outside air)

5. Compare the heating and cooling cycles of the heat pump. (In summer, heat needed for evaporation of heat transfer agent is taken from inside the house. This evaporation cools the coils and surrounding air. This cooled air is then blown into the room by a fan = air conditioning. In winter, the cycle is reversed. Heat is drawn from the outside air, further cooling it. When blown into a room during the condensation stage, the heat warms the room, or supplements the regular room heating.)

Extending the lesson:

1. Investigate the development of heat pumps by pioneer inventors Sadi Carnot, Rudolf Clausius, and Lord Kelvin.

2. Find out why heat pumps are not more widely used. (There has been little effort by electric utility companies, manufacturers, or retail stores to inform the public of their usefulness and energy conservation value. There also were operational problems with earlier models. Heat pumps now are being promoted as energy conservers.)

3. Ask: Why should utility companies be expected to promote a device that saves electricity?

4. Investigate why heat pumps work more efficiently in Florida than in the northern U.S. (Freezing temperatures form frost on outside coils, reducing pump efficiency.)

5. Investigate the differences between water to air heat pumps and air to air heat pumps, and the advantages or disadvantages of each type.

6. Add to the class energy vocabulary list.

Title: People Use The Sun

Concept: The sun is the earth's principal source of radiant energy.

Objective: To discover the relationship between the sun's energy and people's use of it

Introducing the lesson:

1. People have used the energy of the sun through all of history. Ask: Why do we use so little of the sun's radiant energy now? (Energy comes to earth in very diffuse form and concentrating it for use requires extensive and, so far, very expensive technology.)

2. Ask: Do we use any of the sun's energy directly? (only for evaporation and passive home heating)

3. Ask: Why is there renewed interest in solar energy? (Days of cheap fossil fuels are over. Uses of solar energy once considered too expensive are now no more expensive than other kinds of energy.)

Developing the lesson:

1. Investigate the use of direct solar energy in making salt by evaporation near San Francisco Bay.

2. Investigate the construction of solar furnaces in the French Pyreness at Mont Louis by Felix Trombe. (3500 mirrors focus on a small area, producing temperatures of over 6000 degrees Fahrenheit.)

3. Investigate efforts to produce solar cookers. (research of Mouchot, Dr. Abbott, etc.)

4. Ask: Why have efforts to provide solar cookers to people in underdeveloped countries been generally unsuccessful? (high cost; even $10 is more than people can afford)

5. Investigate the development and use of solar water heaters for pools and home heating in Florida.

6. Ask: Why have solar furnaces not been used? (Research for their development halted when cheap fossil fuels became available.)

Extending the lesson:

1. Read in an encyclopedia about people's search for and use of salt produced by natural evaporation. (Include Florida and other southern states during the Civil War.)

2. Investigate the formation of the Bonneville Salt Flats in Utah.

3. Ask: How did the cultural eating habits of people in India and Mexico and other hot countries work against the hopes for use of solar cookers to replace cooking with scarce wood? (They eat their big meal at night, not during the day when a solar cooker could be used.)

4. Build a simple fresh water still with a sheet of plastic and a collecting jar.

5. A farmer in Michigan is operating a solar still to make corn alcohol (moonshine) with which he is operating all of his farm machinery. Ask: Does this sound feasible?

6. Investigate the use of alcohol to make "gasohol" for use in automobile engines.

7. Add to the class energy vocabulary list.

Title: Autos, Autos, Autos

Concept: The automobile is the most personal form of mechanized transport.

Objective: To discover the relationship between people and their automobiles

Introducing the lesson:

1. Ask the students to list the things they most look forward to having when they reach their 16th birthday.

2. Make a class list.

3. Rank the items on the list from those mentioned most to those mentioned only once. (Certainly at or near the top of the list will be "getting my driver's license.")

Developing the lesson:

1. Draw a picture of yourself driving the family automobile on your 16th birthday.

2. Describe how you feel in the picture.

3. Investigate the changes in the lifestyles of people following the development of the Model-T Ford by Henry Ford and developments in automobiles since. Discuss automobiles and:

   a. shopping centers

   b. leisure activities

   c. recreation

   d. pace of life

   e. eating habits.

4. Investigate the development of shopping malls and their effect on the downtown areas of cities.

5. Ask: How has driver education contributed to the desire to drive in young people?

6. Ask: Why do automobile dealers offer free cars to driver educatio programs? (They believe that people will buy the type of car in which they learned to drive.)

7. Discuss the good and bad effects of the automobile on people and their environment. (roads, parking, etc.)

8. Ask: How has the automobile influenced the growth of suburban living?

9. Discuss the kinds of automobiles which have had the greatest impact on people's lives. (Model-T, vans, station wagons, campers, etc.)

10. How about school buses?

Extending the lesson:

1. Draw a picture of yourself if your parents curtail use of the family car because of a gasoline shortage.

2. Ask: How has the automobile changed medical care? (Doctors used to travel to their patients, now patients are driven to doctors.)

3. Discuss how "fast-food" and "take-out" restaurants would be affected by a ban on pleasure driving.

4. Now, discuss how this would affect your lives.

5. How about motels, drive-in theatres, etc.?

6. Considering our dependence on the automobile as a way of life in the U.S., could we go back to an earlier lifestyle without automobiles?

7. Investigate the life in Davis, California; a city where automobiles are not allowed.

8. Draw a picture of your community without automobiles.

9. Write the lyrics to a song entitled, "I Love My Car."

10. Add to the class energy vocabulary list.

Title: Energy To Get Energy

Concept: It takes energy to produce energy for people's use.

Objective: To discover the relationship between the production of energy sources and the cost of energy

Introducing the lesson:

1. In 1859, the first oil well drilled in the U.S. at Titusville, Pennsylvania was 69 feet deep and produced 500,000 gallons of crude oil during the first year. The crude oil sold for 60¢ a barrel. The deepest wells now go down over 30,000 feet into the earth and their crude oil will cost $20 or more a barrel. Ask: Why is the price of oil getting higher all the time? (There are no more 69 foot wells; equipment for drilling and refining is expensive; much energy and labor needed; new supplies are far away and in harsh environments.)

2. Collect pictures of the Alaskan pipeline, offshore drilling rigs, supertankers, men working in harsh environments.

Developing the lesson:

1. Make an in-depth study of the Alaskan pipeline: location; distance; weather; terrain; environmental impact; politics; economics; etc. (This is a classic example of just about every problem with which this lesson deals.)

2. Investigate the costs in energy (including dollars) of oil exploration, drilling, transportation to refinery, refining, transportation to user, cost to user.

3. Ask: Why is the price of energy getting higher all the time? (More energy is used to find it, produce it, and deliver it.)

4. Investigate the process of offshore drilling for oil. (It is the same as on land, except that the platform is out over deep and rough water.)

5. Investigate what has happened to offshore platforms during storms.

6. Investigate the increased cost of unleaded gasoline. (Requires higher refinery temperatures and pressures; requires added chemicals to increase octane rating.)

7. Investigate efforts to recover additional oil from old wells.

8. Ask: Why wasn't this oil pumped out before? (Too costly, but it is now economically feasible as the price of oil rises.)

9. Investigate the effects of oil spills at the terminal for North Sea oil in Scotland. (Damage to sheep and their famous Shetland wool, which is plucked, not sheared, from the sheep, and damage to seaweed on which sheep feed.)

10. Explore the effects of offshore oil rigs on marine life. (Sometines good, as an artificial reef; spills may destroy whole marine environments.)

Extending the lesson:

1. Draw a picture of yourself working on an oil rig.

2. Describe a world in which all energy supplies cost more to produce than the energy they contain.

3. Write a short play dealing with life after oil supplies are gone.

4. Discuss the difficulties in getting politicians to develop an energy policy and an energy conservation program. (Issues are complex, involving multiple interests.)

5. Investigate the results of exploration for oil in the Gulf of Mexico, along Florida's coasts, and in the Big Cypress area of southwest Florida.

6. Ask: Is this a valid statement?: It takes several years between discovery of new energy sources and their availability on the market.

7. Has this always been true?

8. Add to the class energy vocabulary list.

Title: Energy Use In The U.S.

Concept: People use energy to satisfy their needs.

Objective: To discover the relationship betwen people's needs and their use of energy

Introducing the lesson:

1. Make copies of the chart on the next page for distribution to the students. The chart shows U.S. energy use in 1980 as compiled by the U.S. Department of Energy.

2. Note the four major-use sectors: Industrial, Commercial, Residential, and Transportation, and the percentages of energy used by each sector.

Developing the lesson:

1. Discuss the use items within each sector.

2. Discuss the item "feed stocks" and their importance. (raw materials used to make synthetic products)

3. Discuss the relative effect of doing without fuel or feed stocks because of fossil fuel shortages. Which would we miss most?

4. On the basis of a survey of stores in a shopping center, predict whether the amount of oil used for synthetic materials and fibers will increase or decrease. (Use of synthetics is increasing rapidly - check shoes, clothes, etc. from China, Taiwan, Korea, Italy.)

5. Study the chart again. Place an asterisk * beside every item that could be accomplished with electricity. (The use of electricity is growing fastest of all energy forms)

6. Discuss problems of increasing use of electricity. (Blackouts threaten almost every item on the chart.)

Extending the lesson:

1. Discuss whether uses listed in the chart are really uses or conversions of energy to another form.

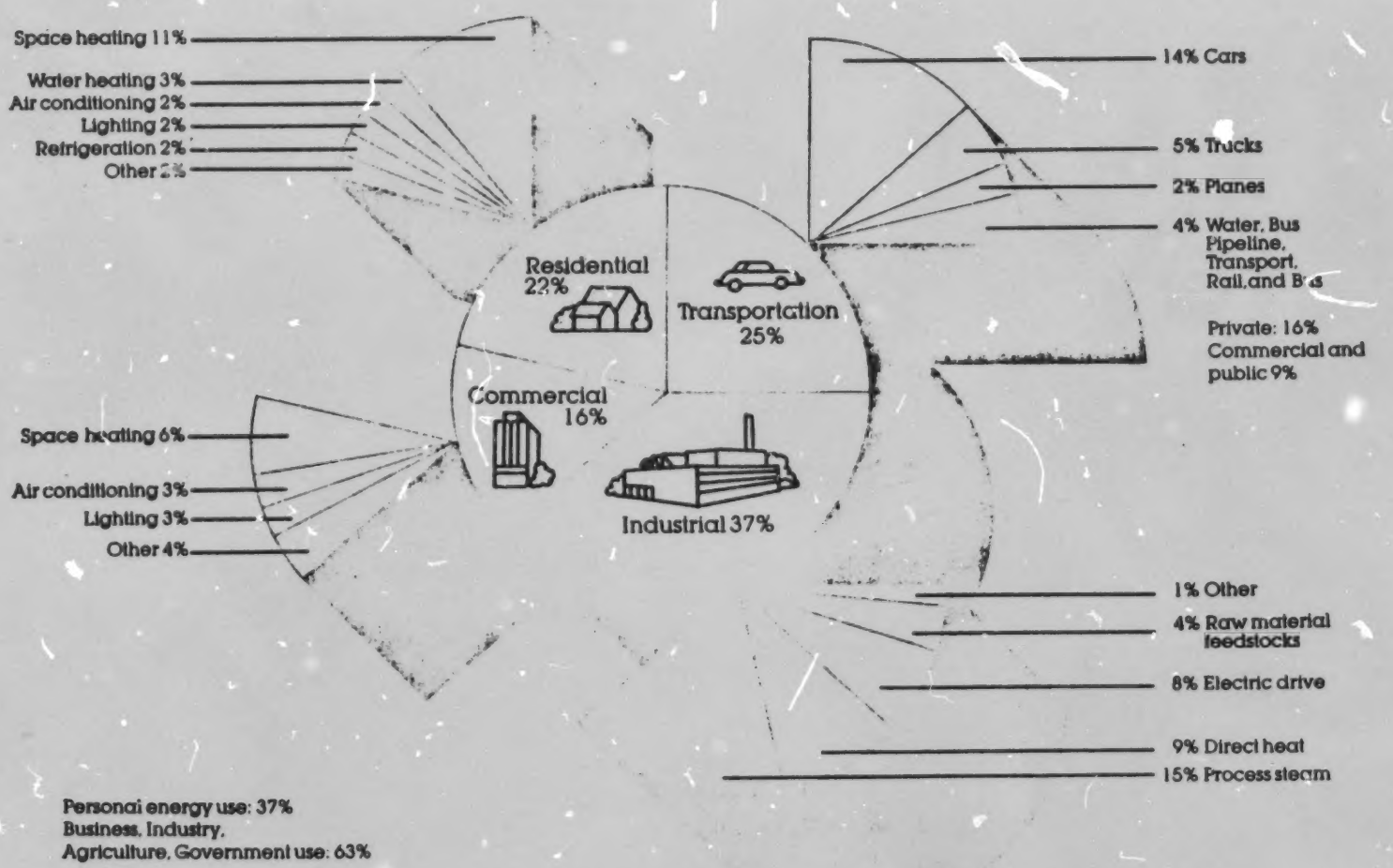
2. Ask: Why is there so little direct use of energy without conversion; for example, direct use of wind in sailing?

3. Draw a picture of a family in an all-electric home without electricity. (This often happens after northern ice storms.)

4. Discuss a program to save electricity for each of the asterisk items on the chart.

5. Add to the class energy vocabulary list.

U.S Energy Usage By Economic Segment



Personal energy use: 37%
Business, Industry, Agriculture, Government use: 63%

1980 U.S. Department of Energy

Title: Limits To Electric Power

Concept: Energy supplies are limited.

Objective: To discover the relationship between supply and demand for electric power

Introducing the lesson:

1. Show a power company advertisement which stresses energy savings. Ask: Why would an electric power company be asking people to conserve electricity when they formerly encouraged people to use more and more electricity? (They are concerned about their ability to supply all the electric power the public demands.)

Developing the lesson:

1. Investigate the reasons for the concern about future supplies of electricity:

   a. Growth in consumption

      1) commercial - (greatest - space heating, cooling, lighting)

      2) residential - (increasing population, more appliances, more inefficient appliances - "frost free")

      3) industrial - (more waste in use of electricity instead of oil, electric furnaces, synthetics)

      4) transportation - (more electric trains)

   b. Increase in waste - (electricity wastes 50-60% of fuel used to produce it -- as heat)

   c. Substitution of electric power for manpower

2. Discuss effects of substitution of electric power for manpower in industry. (A few people can now operate a factory that formerly employed hundreds creating unemployment, increased demand for electricity.)

3. Experts predict a doubled demand for electricity by the year 2000. Discuss the effects on:

   a. number of power plants

   b. the environment

   c. costs of construction

   d. building supplies.

4. Investigate the effects on increased demand for electricity of:

   a. price of electricity (usually cuts demand)

   b. population growth (increase)

   c. economic state (depression decreases demand)

   d. cost of fuels (will determine cost of electricity).

5. Investigate the growth of demand for electricity worldwide.

Extending the lesson:

1. Discuss the pros and cons of siting a new electric power plant in your community or along your favorite stream.

2. Discuss the future of nuclear power plants. (Even without the public concern for the safety and the problems of waste disposal, excessive construction and environmental constraints are making nuclear plants too costly to be economically competitive with coal.)

3. Investigate the future of coal as a fuel to produce electricity. (Coal is plentiful, but lack of transportation into Florida and environmental constraints will limit its use, at least until railroads are updated.)

4. Investigate the status of a coal slurry pipeline into Florida.

5. Ask: Can we satisfy the predicted doubling in demand for electricity? (Only if we are willing to compromise the environmental effects of using coal as a fuel in electric power plants.)

6. Add to the class energy vocabulary list.

Title: Life With Limited Energy

Concept: Some people use more energy than others.

Objective: To discover the relationship between people's lifestyles and their use of energy

Introducing the lesson:

1. Ask the class to collect pictures and news stories of energy supply and use in the nations of the world. (Be sure not to overlook human power.)

2. Assign each student one nation to study and report on.

3. Make a bulletin board display of the pictures and news stories collected.

Developing the lesson:

1. Ask each student to give a short report on energy supply and use in the assigned nation.

2. Investigate patterns of energy supply and use in rural, suburban, urban, and inner city areas.

3. Compare these areas in terms of energy use; energy waste.

4. Compare them in terms of energy conservation.

5. Have the class pick out the five nations that seem most unusual or different from the average in terms of energy use and compare them in terms of:

   a. food

   b. industry

   c. agriculture

   d. transportation

   e. use of electricity

   f. most common fuel

   g. climate.

Extending the lesson:

1. Do a similar comparison for states in each section of the U.S.

2. Discuss the relationships of energy use and environmental problems; for example:

   a. Firewood for cooking is scarce, so people use dried cow manure for fuel. This causes shortage of fertilizer, which results in a smaller crop; less food to cook.

3. Investigate the Kaplan project in Bartow, Florida, which uses wastes from cattle feedlots to produce methane gas.

4. The U.S. has 7% of the world's population, but uses 35 to 40% of the world's energy. Discuss how the U.S. must depend on other nations for some of its energy supplies.

5. Discuss the relationship between energy use and lifestyles.

6. Draw a picture of yourself living in an energy-poor country.

7. Now draw a picture of yourself in the U.S. if energy supplies are limited.

8. Discuss the differences between your pictures.

9. Add to the class energy vocabulary list.

Title: Energy Conflict

Concept: Energy shortages lead to conflict.

Objective: To discover the relationship between supply and demands for energy

Introducing the lesson:

1. Divide the class into 6 groups; each group controls all of one of the following resources in the world: wood, oil, coal, uranium ore, hydro-electric power, irrigation rights. (You may want to have a group for raw materials.)

2. Ask each group to meet to consider how it would use its monopoly of one resource to exert influence or power on the rest of the world.

Developing the lesson:

1. Ask each group to design a display to show their plan for exerting their power in world politics. (They may use charts, graphs, drawings, whatever.)

2. Have each group present their plan to the class. (You will be able to judge the time allotted by the interest shown in the preparation of the group presentation.)

3. Discuss any apparent conflicts which may have to be resolved.

4. Form a committee of one member from each group to meet to discuss any possible compromises that might be worked out to resolve conflicting positions.

5. Have the committee report to the class, and discuss the committee proposal.

6. Ask: What happens if the conflicting plans cannot be resolved in committee? (conflict, war)

7. Investigate the history of energy conflict.

Extending the lesson:

1. Find out what resources people fought for in wars in which the U.S. was involved:

   a. Revolutionary

   b. Spanish-American

   c. Civil

d. World War I

e. World War II

f. Korean

g. Vietnam

h. Middle-East.

2. Do the same for ancient wars: Persian, Greek, Roman, French-Russian.

3. Investigate the influence of Nigeria's oil supplies to the U.S. on American policy toward Rhodesia. (Recognition of a new government might offend Nigeria.)

4. Ask: Why did some U.S. officials recommend military action to guarantee Mid-East oil supplies to the U.S.? (Oil supplies are so vital to the national interest that cut-off of oil supplies is considered an attack on the U.S.)

5. Find people who wage quiet wars with human energy.

6. Find others who use their energy to make peace.

7. Add to the class energy vocabulary list.

Title: A Second Coal Age?

Concept: People depend on their environment for their energy.

Objective: To discover the relationship between energy supplies and the lives of people

Introducing the lesson:

1. Say: One hundred years ago, the nation ran on coal. Then coal was replaced by the cleaner burning and much cheaper oil as the principal source of energy. Now, it appears that, as oil becomes scarce, we may once again become a nation driven by coal.

2. Ask: Do you think this is true?

Developing the lesson:

1. Investigate the advantages of coal in terms of:

   a. abundance. (We have enough for centuries at the present rate of use, but only about 80 years supply if coal is used exclusively.)

   b. accessibility. (We know where it is and how to get it; no costly exploration is needed.)

   c. cost. (is half the price of oil per unit of energy)

   d. uses. (a very versatile fuel and can be converted to oil or gas)

2. Investigate the disadvantages of use of coal as a fuel. (high sulphur content = air pollution, acid rain; mining hazards; environmental hazards - acid wastes; difficulty of reclamation of strip-mined lands)

3. Discuss industry and governmental recommendations that environmental restrictions on mining and burning coal be removed to increase production, at least until technology can be developed to remove sulphur and eliminate acid wastes.

4. Ask: What is coal? (Request samples from local utility.)

5. Investigate stages in the formation of coal. (peat, lignite, bituminous, anthracite)

6. Investigate the location of the world's coal reserves.

Extending the lesson:

1. Investigate the productivity of a coal miner. (10-15 tons per day, but dropping rapidly during recent years)

2. Find out how coal is used in your area and how it is transported.

3. Ask: What is a "captive mine"? (a mine owned by a utility company to guarantee future supplies of coal)

4. Calculate the amount of coal it would take to supply your energy needs and the energy needs of your school. (One lb. of coal = one kilowatt hour of electric power.)

5. Draw a picture of your home and school in the "Second Coal Age."

6. Describe your life if all the environmental effects of using coal are eliminated. (plenty of energy but very expensive)

7. Investigate regulations to increase mine safety.

8. Add to the class energy vocabulary list.

Title: Societies Change

Concept: The lifestyles of people reflect the availability of energy.

Objective: To discover the relationship between energy supplies and the lives of people

Introducing the lesson:

1. Ask the students to compare their energy use with that of an Eskimo.

2. Ask: How is the comparison changing? (Eskimos now have electricity, snowmobiles; rarely use dog sleds and whale oil lamps.)

Developing the lesson:

1. Compare people's need for energy in an industrial nation with that of a developing nation.

2. Investigate the development of the "Green Revolution." (name for intensive program to increase food production in Asia and South America by American scientists)

3. Ask: What were the major ingredients of the program? (hybrid seeds, fertilizers, irrigation, pesticides, and farm machinery, all high energy users)

4. Investigate problems which resulted when high energy farm methods were introduced into nations with limited energy and money. (loss of disease-resistant native varieties of rice and wheat, lack of water for irrigation, costs)

5. Ask: What kind of energy are the poor people of the world interested in? (food for human energy or fuel for cooking)

6. Check the validity of the statement: "If the poor people of the world had all the food they needed, they would not have enough fuel to cook it." (true)

7. If this statement is true, discuss its implications for the future. (overpopulation can only increase shortages)

8. How has the increase in the world's population affected various societies and nations?

Extending the lesson:

1. Calculate how many people the earth could support at the U.S. standard of living. (Our 200 million people use nearly one-third of the world's energy, so the earth could support three times as many people as the U.S. standard of living or 600 million.)

2. How many could the earth support at the standard of living of the people of China? (1 billion people use less than 10% of the world's energy = over 10 billion)

3. Draw a picture showing Americans visiting a poor nation.

4. Draw a mural showing poor people visiting the U.S.

5. Draw a picture of yourself in a new society that has been forced to live on a limited energy budget.

6. Describe your new society and life in it.

7. List the items you own but would have to give up in the new society.

8. Ask: Is it fair for our society to use up the fuels on which future societies must depend?

9. Add to the class energy vocabulary list.

Title: Clean Air?

Concept: People and environments are dependent on one another.

Objective: To discover the environmental costs of our high energy technological society

Introducing the lesson:

1. Ask the students to list the measures that state and federal governments have taken to control pollution of air and water.

2. Investigate the role of the U.S. Environmental Protection Agency and the Florida Department of Environmental Regulation in setting up and enforcing air and water pollution control regulations.

Developing the lesson:

1. Ask: What is the role of legislative bodies (Congress and state legislature) in providing clean air? (They set policy, allowable pollution levels, set up and fund regulatory agencies.)

2. List the major polluters of the atmosphere and the pollutants they produce. (automobile - smog, nitrogen oxides, carbon monoxide, lead; electric power plants - sulphur dioxide, soot, ashes, excess heat)

3. Investigate the operation of emission control devices on automobiles and the loss of gasoline mileage. (7%)

4. Discuss whether clean air standards should be eased to increase gasoline mileage.

5. Investigate costs of air pollution. (approximatley $20 billion per year: health effects; effects on materials - rust and corrosion; effects on homes - paint; crop damage; aesthetic effects)

6. Investigate the formation of acid rain. (Sulphur dioxide from burning fossil fuels combines with water vapor to form sulphuric acid which falls to earth in rain. It is causing erosion of marble buildings and statues worldwide and ruining bodies of water.)

7. Investigate air quality standards for your local power plant and the supply problems they cause. What is being done to reduce air pollution?

8. Compare the national policies of the Carter administration with the Reagan administration in regard to clean air standards.

Extending the lesson:

1. Ask: Do you favor relaxing clean air standards in order to provide cheaper electricity?
2. Discuss this or have a debate if opinions differ widely.
3. Write about a trial concerning clean air violations. (or conduct a trial)
4. Draw a picture of your community if there were no clean air standards.
5. Draw another picture showing your community with a solar electric power plant.
6. Ask: Do the values of people vary according to the effects of the pollution or regulations on them?
7. Discuss the values expressed.
8. How can the problems of both power production and air pollution be solved?
9. Add to the class energy vocabulary list.

ENERGY AND MY ENVIRONMENT

SUPPLEMENTAL ACTIVITIES

FOR

GRADE SIX, GRADE SEVEN, GRADE EIGHT

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Title: A Calorie Count

Purpose: To develop understanding that food is a source of energy

Materials: Pencils, paper, crayons, seed samples of wheat, oats, barley, rice, corn, millet (Put each sample of seed in a separate bowl.)

Processed cereals: Buckwheat, Grapenuts, Shredded Wheat, Puffed Rice, Cheerios, Cornflakes, Rolled Oats. (Choose three or four from each group if you cannot get them all.)

Procedure:

1. Food energy is found in nutrients. (proteins, carbohydrates, fats, etc.) Energy is released into the bloodstream during the process of digestion. Sugar is released faster than the other food elements, but it is not the most nutritional. Food energy is measured in calories.

2. Ask the children to look at the grains in the bowls. After a few minutes, ask them to describe each kind. What color is wheat, corn, oats, etc.? How big are the cereal grains? Which are big? Small? What does wheat, corn, oats, etc. feel like? Would you want to eat them? Do you sometimes eat them? Do you know what kind of grain each one is? (Help them to identify each one.) In what form do you eat this grain? (Wait for someone to suggest breakfast cereal, then place breakfast cereal boxes on the table letting children match each cereal with the grain it is made from.) Most cereal boxes have the grain illustrated. Pictures of grains are shown in The World Book Encyclopedia.

3. Develop the lesson by asking: Do you eat cereal in the morning? Why do you eat it? (gives energy.) What other foods give energy? (Let them name several different foods.) When you eat food, do you think about how your body changes it into energy? What do teeth do to food? (break up the food into smaller pieces) Where in our bodies do changes take place? (mouth, stomach) Show me where your stomach is. What happens to food in there? (That's where the food gets changed to chemicals that go to the cells all over your body, where it's changed into energy.)

4. Then say: Find your heart, and feel it beat. You will need to remain very quiet. When you feel it beat, stand up. Conclude this part when most of the children are standing. Then say: Let's do some jumping jacks together. Do at least ten. Now sit down and find your heart again and feel it beat. Is it beating slower or faster than before? Did you use more food energy when you were jumping? When you use up most of the food energy your body has stored, what do you think happens? (You feel hungry, and you know it's time to eat again.)

5. Pass out newsprint folded in half, crayons, and pencils. Say: Think about your favorite food. On the left side of the paper, draw a picture of yourself eating your favorite food. On the right side of the paper, draw something you can do with the energy from that food. (run, jump, etc.) Write a story about your pictures. (Use the pictures for a bulletin board or language experience chart, or let the children take them home.)

GRADE 6, UNIT I, LESSON 2

Title: "Power"

Purpose: To identify three forms of energy and explain some of the ways energy is used in the school

Materials: Paper with one or two lines at the top and bottom, and space for a drawing between, pencils, crayons

Procedure:

1. In advance of the day's lesson, arrange with the school custodian for a suitable time to visit the boiler room. Plan with the cafeteria staff for an appropriate time to visit the kitchen. You may wish to arrange for a class visit to the school office and school library.

2. Prepare your children for any of the trips you take around the building. These places may be visited in any order. Be sure the children know they are to look for places where energy is being used. What you see will depend on your particular school building. Have them watch for things that produce motion, heat, or light energy. You may choose to use one or more of the following trips:

   Boiler Room -- Children should notice the furnace and the hot water heater, water pumps and air blowers. Energy forms are heat, motion, and light.

   Cafeteria -- Children should notice the ovens (heat), refrigerators (heat/cool), dishwasher (heat, motion), mixer (heat, motion), slicer (heat, motion), etc.

   Library -- movie projector (heat, motion, light).

   Office -- electric typewriter (motion), bell system (sound, motion), fluorescent lamp (light).

3. Following the trip, ask the children to choose three things they saw on the tour that showed three forms of energy being produced - heat, light, and motion. Draw pictures illustrating these three things.

4. Make up some riddles to recall some of the energy users seen on the tours:

   a. In the office we saw something that was on a desk, moved and used electricity. It was a _____. (typewriter)
   b. In the library we saw something that used a light, had two spools that moved and used electricity. It was a _____. (projector)
   c. In one room we saw something that uses oil and gives off heat. It was a _____. (furnace)
   d. We saw something that gives off heat energy, has a light in it and uses electrical energy. It was an _____. (oven)
   e. We saw something that has a round base, twirls around and uses electricity. It was a _____. (floor polisher)
   f. We saw something that uses electricity and makes a noise. It was a _____. (bell)
   g. We saw something that was rectangular, uses electricity and makes things cold. It was a _____. (freezer)

GRADE 6, UNIT I, LESSON 2

Title: "Power"

Purpose: To create an awareness of current reference materials on energy and to develop organizational skills

Objective: To help students focus on the "What, Where How and Why" of four selected energy sources as they explore reference materials and become aware of available energy sources.

Materials: Mini-packet on "How's Your Energy?" Students will locate their own reference materials.

Procedures:

1. Have students complete mini-packet.

2. Say: Most of us use the word "ENERGY" every day of our lives. I have just lost all of my ENERGY. There is supposed to be an ENERGY crisis. The sun's ENERGY is warming the air. Our house is designed to save ENERGY. We all use the word but do we all know what we are really talking about? What is ENERGY, and where do we get it?

3. Say: Using reference books such as textbooks, encyclopedias, dictionaries, magazines, etc., do the following exercises to the best of your ability. The total packet is worth 100 points and will be evaluated as follows:

   - o 20 points - introduction
   - o 60 points - research - 15 points for each source
   - o 20 points - experiment, demonstration or drawing used to show how one of the energy sources is available to mankind.

4. Say: We use several forms of energy each and every day of our lives. Write the definition of energy as stated in four different reference books. List the book, its copyright date, and the definition.

5. Say: According to the thinkers of our day, all matter in the universe contains energy. Albert Einstein suggested that the relationship between matter and energy is a very close one. In fact, he suggested that one day we will understand how to convert matter into energy and energy into matter. This sounds good to most people, but just what is matter? List at least six different forms of energy which might be available to you on a daily basis.

6. Have students write the definition of matter as stated in three different reference books. List the book and its copyright date with the definition.

7. Say: Using your definition of matter, list at least five forms of matter that you came in contact with on your way to school this morning.

   If all the matter listed contains energy, and the energy is not doing some work, (causing something to move) then it must be stored energy. We call this _____ energy. The matter which came in contact with that which was causing something to move or do work can be said to possess _____ energy.

HOW'S YOUR ENERGY?

RESEARCH

It becomes clear that our lives are dependent upon many forms of energy to help us do work. We drive cars, heat our homes, light our schools, grow our food, and in general use it for survival and convenience. In almost all cases, this energy is not readily available in the form we can use. For example, we cannot pick up a sunbeam to run a fireplace. Other than direct solar energy, energy to heat your room is locked up in wood, coal or petroleum. As intelligent human beings, we have been able to take this potential energy and convert it into kinetic energy to serve our needs. We are the only animals on earth that have been able to do so.

One form of energy used by man is in the form of heat. Heat keeps us warm, moves our motors and machines, make our meals, and provides us with artificial light. (electricity)

In the remaining portion of this lesson, we will explore some potential sources of heat energy that are available to the world's human population.

Select four potential sources of heat energy used by people, e.g., coal, peat, natural gas, oil, etc. Research each heat source. Be sure to list reference, author and date the article was presented.

1. What source of potential energy are you investigating?
2. What is the energy used for?
3. What percentage of the United States energy is supplied by this source?
4. Where can this energy be found in greatest abundance?
5. Where does the United States obtain this source of energy?
6. Where are the waste products used, stored or gotten rid of?
7. How do we collect this energy?
8. How efficient is this energy as a source of heat?
9. How is this energy stored for later use?
10. How much energy is remaining for our future use?
11. Why is this a good source of energy?
12. Why is this a poor source of energy?
13. Why isn't this source of energy used more extensively?
14. Why are we concerned about the future use of this energy source?
15. In your opinion will we be using more, less, or the same amount of this form of energy in 1990?

DEMONSTRATION

Pick one of the four sources of potential energy researched and demonstrate, either with an experiment or with a drawing, how that energy is made available for man's use. Demonstrations in which quantitative data are presented will be valued more than simple illustrations of principles.

Title: "Power"

Purpose: To recognize the many forms of power

Procedure:

1. Take a few moments to allow students to brainstorm how many kinds of power they can name. Include actual types (electrical, wind, solar, etc.) and descriptive types (noise, brain, slow, etc.).

2. Have each student demonstrate, in turn, a type. Then have the students assemble in various groupings (e.g., manmade, natural, human, industrial, Florida, etc).

3. As a grand finale, have everyone do their thing at the same time!

Title: An Appliance "Energy Chain"

Purpose: To perform a physical demonstration of the relationship of energy and ordinary appliances

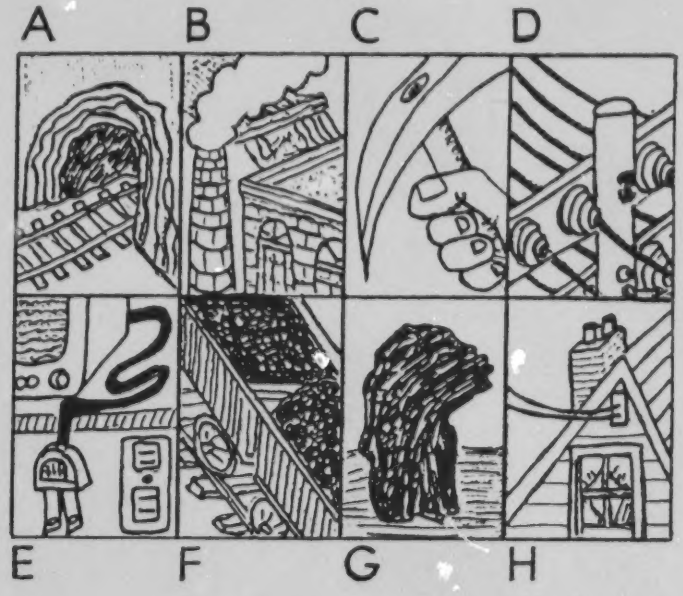
Materials: String, poster board, felt pens, duplicated copies of "Did You Ever Wonder Where The Electricity For Your TV Comes From"

Procedure:

1. Have students choose a common household appliance to use for this activity.
2. Using signs, identify one student as the appliance, others as the raw materials, production, transportation and marketing systems.
3. Have some students identified as energy types. (electricity, diesel, water, etc.)
4. Then use the string to connect the related components which should result in a complex web. Show the process leading to electrical energy for those appliances by using this worksheet:

DID YOU EVER WONDER WHERE YOUR ELECTRICITY COMES FROM?

STEP 1. ____
STEP 2. ____
STEP 3. ____
STEP 4. ____
STEP 5. ____
STEP 6. ____
STEP 7. ____
STEP 8. ____



ANSWERS: 1.C 2.G 3.A 4.F 5.B 6.D 7.H 8.E

GRADE 6, UNIT II, LESSON 2

Title: Concentrated Energy

Purpose: To discuss a form of energy and how it changes

Materials: Charcoal briquets, pie plate filled with sand, tongs

Procedure:

1. Either pass around or display some charcoal briquets. Generate discussion on what kinds of energy they represent and how this energy is produced from wood.

2. Hold a charcoal briquet with tongs (over sand-filled pie plate) and light the charcoal briquet with a match. Watch it burn. When the charcoal briquet has burned into ash, discuss if it is still a source of energy.

GRADE 6, UNIT II, LESSON 2

Title: Concentrated Energy

Purpose: To understand how energy is converted from one form to another

Background Information: Energy is a fixed commodity, being neither created nor destroyed but converted from one form to another. The means of conversion are important.

Procedure:

1. During the consideration of how energy is converted from one form to another arrange to take the class on a "field walk."

2. Students, working together in groups of two or three, should be challenged to list all the energy conversions they can see or hear during a 15-20 minute walk.

3. Ask each group to list their findings as follows:

Object Viewed or Heard	Energy Source	Conversion Product
Moving automobile	Gasoline	Motion
Moving cloud	Wind	Motion
Neon Sign	Electricity	Light
Siren	Electricity	Sound

4. Ask each group to share its list with the class. On the chalkboard, make a master list of group findings.

   a. How many examples were reported by every group?
   b. What type of energy source predominates?
   c. What type of energy product is most common?
   d. Is electricity a "primary" or "secondary" energy source?
   e. What intermediate conversions might occur between an energy source, such as gasoline in an automobile, and the motion of the vehicle?

Title: Heat Is Lost

Purpose: To identify the essential element of heat loss

Materials: Candle, matches, 4-6 thermometers (0-50°C), tape, 1 water glass and styrofoam cup of equal size, magnifying glass

Procedure:

1. Light the candle. Hold the candle near the door and windows.

   a. What does the flickering represent? (air moving)
   b. What can be done to door and windows to prevent escape of heat? (weatherstrip, caulk)

2. Attach thermometers, near ceiling, floor, by a window, door and on an inside wall and an outside wall. Record the readings.

	9:00	11:00	1:00	3:00
Ceiling				
Floor				
Window				
Door				
Inside Wall				
Outside Wall				

   a. Where is the room warmest?
   b. What is the coldest location?
   c. How is the heat moving around the room?
   d. How can window temperatures become warmer?

3. Have a small group of students put equal amounts of hot water in an ordinary glass and a styrofoam cup. Take the temperature of water in each. Place pieces of cardboard over each container to insure heat loss is through the container, not the opening.

4. After 1 minute, record the temperature of the water in each container.

   a. In which container did the water stay hotter?
   b. Why?

5. Ask students to examine bits of styrofoam cup with a magnifying glass and tell what they see. (air pockets) How can air pockets keep heat in? (Air cannot carry heat away if it is trapped in the pockets.)

GRADE 6, UNIT III, LESSON 2

Title: Energy Inventors

Purpose: To relate past and present uses of energy to our future

Procedure:

1. Have students research and discuss inventions that have shaped our present society.

2. Ask each student to think of something that hasn't been invented yet.

3. Have students prepare a paper about how their invention will use energy, conserve energy, and how it will affect the environment.

GRADE 6, UNIT III, LESSON 2

Title: Energy Inventors

Purpose: To compare energy sources of an earlier time with those of today.

Procedure:

1. During a study of pioneer life, attention will be given to how food, clothing, and shelter were provided at that time. It should be pointed out that the energy sources used to do most of the work in the pioneer family unit were (1) human muscle, (2) animal power, and (3) wood.

2. Divide the class into three groups: food, clothing, and shelter. Ask each group to research, through reading and interviews, how each basic necessity was produced in pioneer times before electricity was available. Ask each group to research how electricity is used today to produce the food, or clothing, or shelter we use.

3. Ask each group to summarize its findings to the class and indicate what changes we would need to make in the way we live if we had no electricity.

Title: The Sun Affects Our Climate

Purpose: To learn about the sun as a source of energy

Materials: Box of cereal, 2 plants of the same kind

Background Information: The sun is a primary source of energy for all plants on earth. Plants use energy from the sun to combine minerals from the soil with carbon dioxide from the air to make starches and sugar. The process is called photosynthesis. Today we can collect the sun's energy in photocells or in glass-covered boxes which are blackened inside. The photocells convert the sun's energy to electricity. The energy absorbed in the glass covered boxes (called "solar panels") can be used to heat water flowing over them in pipes or tubes. This hot water can then be stored for use, or used to heat a home.

Procedure:

1. A week in advance of the lesson put one plant in a dark place and a similar one in the light.

2. Hold a box of cereal before the class. Say: I saw on TV a commercial for breakfast cereal. The announcer said that this breakfast cereal could give me energy. How could a breakfast cereal give me energy?

3. Another way of proceeding is to ask the children who have pets at home to stand. Do animals also get energy from food? (Call on each child who is standing.) Ask: What kind of pet do you have? What do you feed your pet? How does your pet use the energy in the food?

4. Discuss the following key questions:

   a. If we get energy from food, and animals get energy from food, how do you suppose plants get energy?

   b. Are plants living things?

5. Say: The sun gives light energy which is used by plants.

6. Place the two plants in front of the class; the plant that was grown in the light and the one grown in the dark. Explain where each had been growing. Have the class observe differences. (The one grown in the dark is likely to be taller and a lighter color, whereas the one in the light will be a healthy, green color; bushier.)

7. Compare the conditions for growth of the plant grown in the dark with the one in the light. Bring out the fact that sunlight made the difference. Sunlight is necessary for the growth of most plants. We get light from the sun.

8. Say: We also get heat from the sun. Did you ever get sunburned? If so, where did the heat come from?

9. Find other examples to show that the sun is a source of heat. Go outside and touch a wall that the sun is shining on. Now touch a part of the wall made of the same material but in the shade. Which is hotter? Use thermometers to measure the temperature of the part of the wall in the sunlight and that in the shade. Compare.

10. Block one pane of glass with black paper so that the shadow falls on the window sill. Put one hand on the sill where the sun is shining and the other in the shaded portion of the window sill. Which is warmer? Why?

11. Make a class story giving some facts you have learned about the sun. The following are basic facts:

OUR SUN

THE SUN GIVES LIGHT.
THE SUN GIVES HEAT.
PLANTS NEED SUNLIGHT IN ORDER TO GROW HEALTHY.
PEOPLE AND ANIMALS NEED SUNLIGHT.

GRADE 6, UNIT IV, LESSON 1

Title: The Sun Affects Our Climate

Purpose: To determine that water is important to all living things and that solar energy can be used to collect water

Materials: Light plastic sheeting about 4 ft. square, pieces of cactus or any moisture-collecting plants, jar or can, shovel

Procedure:

1. Choose a sunny day for building a solar still.

   a. Dig a hole about 3 ft. across and about 1½ - 2 feet deep in a sunny and moist place.

   b. Place the large pieces of cactus in the hole.

c. In the center of the hole, place the jar or can.

d. Place the plastic over the hole and weigh down the edges with rocks.

e. Place a stone in the middle on top of the plastic sheet above the approximate center of the jar or can.

f. Moisture from the soil or plants will be drawn up by the heat of the sun. Moisture in the cooler air above the plastic will condense. The moisture will collect and run down the plastic to the lowest point where it drips off into the container. 1 to 5 pints of water may be collected in a day.

2. Write a story about how it would feel to be able to get only 1 to 5 pints of water a day and what you would do with this small amount of water.

GRADE 6, UNIT IV, LESSON 2

Title: People Worship The Sun

Purpose: To create thoughts on how we use the sun directly

Procedure:

1. Get the class thinking of ways we use the sun to warm and color ourselves. (Direct exposure is the most obvious, but don't forget solar lamps or even pills or lotions that darken the skin without exposure.)

2. Have the students list things and methods used to "worship the sun," such as goggles, reflectors, suntan products and beach umbrellas.

3. Discuss greenhouses. In greenhouses, glass allows the short-wave radiation of the sun to pass through. When things inside the greenhouse "warm up," they reradiate long waves which the glass blocks. This "greenhouse effect" is why a closed-up car gets very hot inside when it's in the sun.

Title: Energy For Transportation

Purpose: To study the effects of friction/resistance to movement

Materials: State Road Map

Procedure:

1. Say: To conserve energy, it is evident that one must accomplish a task with the minimum amount of work. In the process of doing work, the less resistance, drag or friction one must work against, the less energy is expended.

2. Copy the following problem on the chalkboard: Suppose a car averages 20 miles per gallon of gasoline on long trips when the suitcases are on a luggage rack on top of the car. By putting the luggage in the car (reducing air friction) you get 8% better mileage.

3. Using a map of your state, figure the number of miles from a city on the west side to a city on the east side.

   a. Compute the number of miles per gallon the car would gain with the luggage in the car.

   b. Compute the number of gallons, the nearest tenth, used in traveling with the luggage on top of the car; in the car.

   c. Assuming a cost of $1.35 per gallon, determine the money saved on the trip by packing the luggage in the car instead of on the roof.

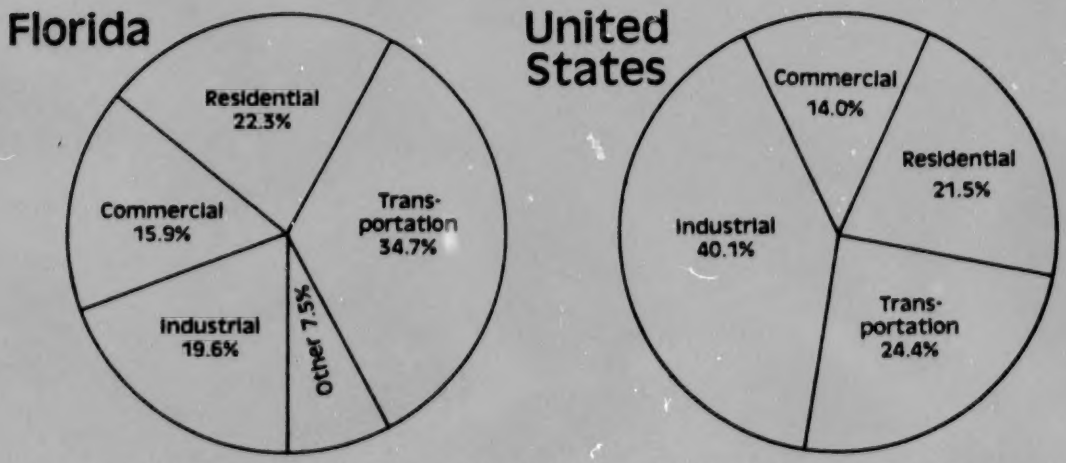
Title: Energy Use In Other Nations

Purpose: To determine how the United States uses more energy than underdeveloped nations

Procedure:

1. Discuss this statement: The United States has but one-sixth of the world's population, yet we consume over one-third of the world's energy. Why?
2. Draw pie graphs on the chalkboard and discuss.
3. After studying the pie graphs, the students should be able to define the items and procedures that are not used in underdeveloped countries but are prevalent in the U.S.

Percentage of Total Energy Consumption by Sector—1980



The consumption of energy in Florida differs from that of the country as a whole. The transportation sector is the largest energy consuming sector in the State. In 1980, transportation accounted for 34.7 percent of energy use in Florida, but only 24.4 percent of the nation's. While over 40 percent of the country's total energy consumption was in the industrial sector, industry accounted for less than 20 percent of energy use in Florida.

GRADE 6, UNIT VI, LESSON 1

Title: A "Do-It-Yourself" Blackout

Purpose: To determine the feasibility of living without electricity at this exact time

Procedure:

1. Prior to doing this activity, have students identify older (80's or late 70's) relatives or neighbors who are willing to answer questions about their childhood. (Perhaps have some of them come to the classroom to act as resource persons.)

2. Have students ask the "old timers" how and with what they or their families accomplished the following tasks when they were children.

    1. Cooked
    2. Washed clothes
    3. Dried clothes
    4. Studied or read in the evening
    5. Kept warm in the house
    6. Stored food
    7. Traveled distances

3. Discuss: If our community had a "black-out" for several days, could our families continue their normal way of living? During this period of "black-out," could we manage as the 70 and 80 year olds did in their youth?

GRADE 6, UNIT VI, LESSON 2
(Continued)

Title: A World Without Energy

Purpose: Energy is essential to humankind

Procedure:

1. Have students research the history of energy sources and uses through time.

2. Have students design a mural showing how they think the world has looked and will look as various sources of energy have been used through history and will be exhausted in the future. (include a time line)

Title: Lifestyles And Energy

Purpose: To appreciate how dependent our standard of living is on energy

Materials: Expendable magazines and newspapers, copies of LIFESTYLE SURVEY FORM on next page

Procedure:

1. Schedule a picture-clipping session to have students cut out scenes or items that portray the current scene.

2. Have the students individually create a collage of their clippings or a large mural or poster.

3. As a class project, using multi-colored felt pens, line out those things that would no longer be available as energy sources become limited and then extinct. (Don't forget by-products such as synthetics, medicines, and plastics made from petroleum.)

4. Duplicate the "Lifestyle Survey Form" on the following page. To elicit student values regarding electrical appliances and their views of a desirable lifestyle, have students follow directions to describe their feelings about giving up particular items listed.

5. When students have finished, discuss answers given and tally on a master sheet.

6. Discuss results compiled on the master sheet.

7. Assign students to write compositions about how dependent our standard of living is on energy, how their personal uses of energy is determined, and how they feel about making energy-use choices.

LIFESTYLE SURVEY FORM

Place an X in the column which best describes your feeling about giving up a particular item.

ELECTRICAL APPLIANCE OR ITEM*	Do Not Have	Very Easily	With Some Difficulty	With Great Difficulty	Impos-sible
Radio					
Stereo					
Air Conditioning (at home)					
Air Conditioning (at school)					
Electric Fan					
Clock					
Freezer					
Typewriter					
Copy Machine					
Water Heater					
Power Tools					
Refrigerator					
Iron					
Dishwasher					
Electric Mixer					
Doorbell					
Electric Stove					
Hair Dryer					
Elevator					
Toaster					
Electric Blanket					
Garbage Disposal					
Blender					
Lights					
Clothes Washer					
Electric Guitar					
Telephone					
Sewing Machine					
Trashmasher					
Electric Curlers					
Color TV					
B/W TV					
Electric Tooth-brush					
Clothes Dryer					

*Add any other items you may have in your home.

Title: Lifestyles and Energy

Purpose: To have students apply their knowledge of energy and problem-solving to a situation that is important to them

Procedure:

1. Have each student choose a particular energy problem important to them. Discuss the main dimensions of each individual energy problem. Discuss the following questions:

   a. What is your energy problem? (e.g., turning off lights, saving heat, recycling products, driving fewer miles, organizing a community campaign for saving energy)

   b. What actors are involved in your energy problem?

   c. What issues are you trying to solve?

   d. What actions are you thinking about doing?

   e. Why are these actions important?

2. Help students plan how to actually take action on the problem they have defined. Have them use the "Taking Your Own Action" form. Help them to respond to each of the sections of the form. You may want to talk orally about each of these sections and put the answers on the board. Or you may want students to work in groups. They should, through this discussion, define the problem that they are trying to solve; talk about the information they need in order to solve it; list the people who are involved in working on the problem; determine who will do what in tackling the problem; decide at what time each person will take his or her action; and finally, decide on what form the report will take. You should go through each one of these steps with the students and help them to work out a realistic and well-reasoned plan for taking action on their problem.

TAKING YOUR OWN ACTION

My Energy Problem _____

Information I Need _____

Who Will Do Things? _____

When We Do Things _____

Report _____

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3. When students are taking action on their problem, you should talk with them regularly about how they are progressing. You may want students to give oral reports to you on a regular basis. You may want them to keep written logs of their activities so that they can remember what they have done. You should be a central stimulus and resource for students as they are carrying out their activities.

4. Have students give reports to the class on their success in taking their own action. They may make these reports in oral or written form, or use visual aids, such as pictures they have made or pictures or articles that have been taken from newspapers or magazines. They can present these reports to other classes in the school or to groups in the community via the P.T.A., newspapers, etc.

5. When students have completed their reports, have the class make a set of recommendations about how people might save energy. Write these recommendations on the board.

6. Have students prepare letters or memoranda to send to the proper people who make decisions in this area so that others may learn to save energy. Discuss the responses that are received in answer to their recommendations.

Title: Energy Waste -- Or -- Conservation?

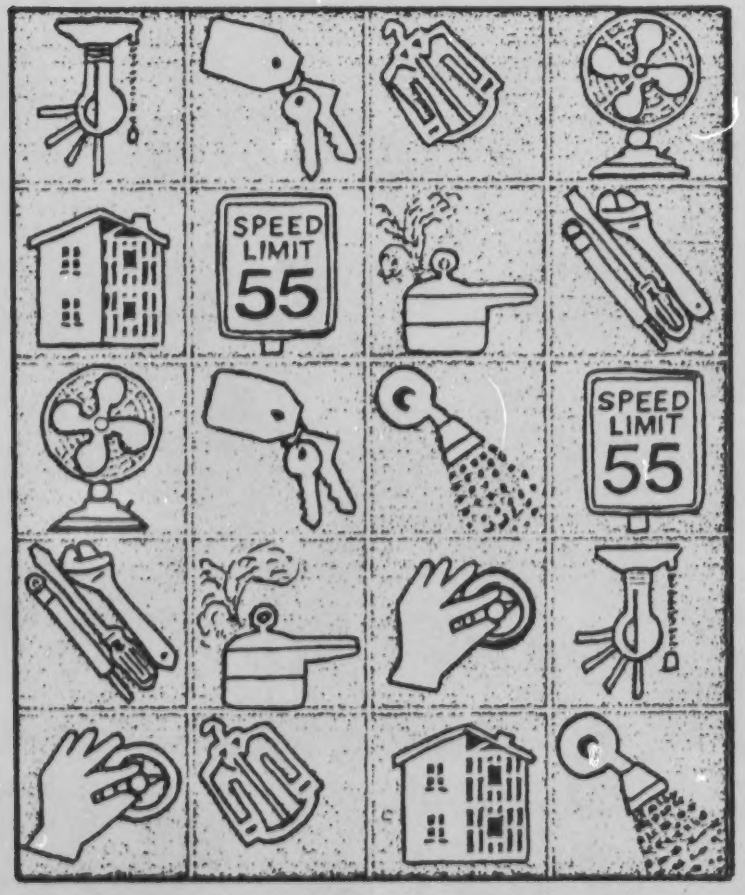
Purpose: To promote conservation by reducing waste

Materials: Energy saver pictures

Procedure:

1. Reproduce the energy saver pictures on heavy paper and then cut out each square.

2. Play a game of "concentration" by shuffling and turning the pictures face down. The players then pick two random squares and attempt to match a pair. When they do (to get a point), they must name a related conservation idea that will reduce waste. Write these down by pair groupings. In subsequent rounds, different conservation ideas must be named in order to get points. Play toward a point or time limit.

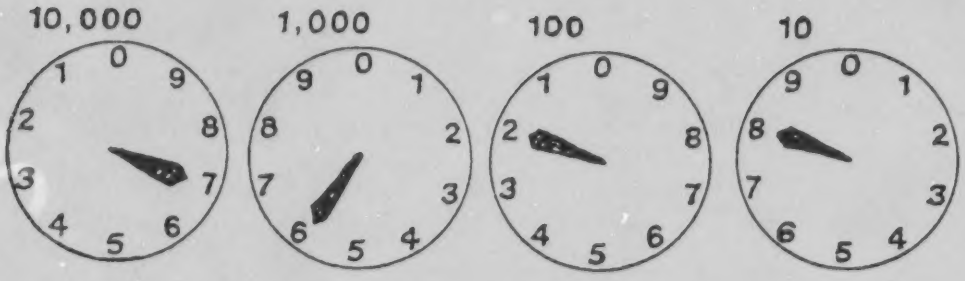


Title: Energy Waste -- Or -- Conservation?

Purpose: To learn how to read electric meters to tell how much energy we use

Procedure:

1. READ LEFT TO RIGHT:



AVERAGE MONTHLY KWH

Range	100	Electric heater	28
Electric Skillet	15	Electric heat pump	760
Toaster	4	Electric heat for house	790
Washer	7	Central air conditioning	808
Dryer	65	Room air conditioning	425
Iron	14	Refrigerator	195
Hot water heater	300	Freezer	178
		TV	150
		Stereo	100

2. If you could use only 1200 KWH each month, what appliances would you use?
3. Locate your electric meter at home.
4. Turn off as many energy users as possible.
5. See how long it takes your meter's dial to revolve 10 times.
6. Turn on a single light and see how many seconds quicker the dial revolves.
7. Do the same with other appliances and make your own chart rating appliances; record player, radio, iron, stove and others.

Title: Energy Waste -- Or -- Conservation?

Purpose: To determine ways to conserve electricity at home and at school

Materials: Copies of TEST YOUR ENERGY E.Q. and WHAT'S YOUR E.Q.? (on following pages)

Procedure:

1. Have students collect their family's electric bills for three months. Find the number of kilowatt hours (KWH) on each bill. Add the KWH for the three bills. Divide by three.

2. How much electricity does each family average each month? Try to reduce the amount of electricity each family uses. Compare the bills after several months. Do you see any difference.

   Ask: Why should you be concerned about the amount of electricity you use?

3. Have students do exercise TEST YOUR ENERGY E.Q. on the following pages. Discuss questions and answers.

4. Have students suggest ways your school could save electricity. Ask your principal to review your list and comment on it. Can any of these ideas be tested?

5. Have students do exercise WHAT'S YOUR E.Q.? that follows TEST YOUR ENERGY E.Q.

6. Discuss questions and answers.

TEST YOUR ENERGY E.Q.

Take this quiz to check your knowledge of energy-environment issues.

1. ____ How much of the energy used in gas stoves supplies the pilot lights?

   a. 10% b. 25% c. 50%

2. ____ If an incandescent lamp and a fluorescent lamp have the same light output, which uses energy more efficiently?

   a. fluorescent
   b. incandescent
   c. both about the same efficiency

3. ____ How many soft drink cans can be manufactured from recycled aluminum with the energy needed to make a single can from aluminum ore?

   a. three b. five c. twenty

4. ____ How long would a 100-watt light bulb burn on the energy needed to manufacture one throw-away soft-drink can or bottle?

   a. 10 minutes b. 5 hours c. 20 hours

5. ____ How much of the energy stored in crude petroleum is lost between the oil well and a moving car?

   a. 20% b. 60% c. 90%

6. ____ The heat energy of a gallon of gasoline is equivalent to

   a. 5 man-days of labor
   b. 15 man-days of labor
   c. 25 man-days of labor

7. ____ How much faster than their rate of production are we consuming our fossil fuels?

   a. 10 times b. 1,000 times c. 1,000,000 times

8. ____ What fraction of the world's energy consumption occurs in the U.S.?

   a. Over 10% b. Over 20% c. Over 30%

9. ____ Which of the following fuel resources is in greatest danger of exhaustion?

   a. coal b. petroleum c. natural gas

10. ____ In the year 2000, American total energy demand will be:

    a. the same as today
    b. twice as much as today
    c. three times as much as today

ANSWERS: TEST YOUR ENERGY E.Q.

Score 1 for each correct answer. 0-5 Poor, 6-7 Fair, 8-10 Good.

1.(c) Approximately half of the gas used in a gas stove is used to fuel the pilot lights because pilot lights burn continuously.

2.(a) Fluorescent lights give off three to four times as much light per watt of electricity used as incandescent lamps do. One 40-watt fluorescent light gives more light than three 60-watt incandescent bulbs, and the annual savings may be as much as $10.

3.(c) Aluminum is a very energy-intensive material with the largest share of the energy going to process the ore. Recycling is a great energy saver. The nation's total throwaway containers' equivalent energy waste is equal to the output of 10 large nuclear power plants.

4.(b) A 100-watt lamp could burn for 5 hours on the energy used to manufacture a disposable can or bottle.

5.(c) Ninety-four percent of the energy in the gasoline from crude petroleum is lost in making your car move. The efficiencies of the most important steps where energy is lost are:

producing the crude oil	96%
refining	87%
gasoline transport	97%
engine thermal efficiency	29%
engine mechanical efficiency	71%
rolling efficiency	30%

The total efficiency of the system is found by multiplying the six factors together: 6%.

6.(b) 15 man-days of labor. Said in another way, one barrel of oil contains heat energy equivalent to the energy of a man at hard labor for 2 years.

7.(c) In less than 500 years, man will have consumed essentially all of the coal, oil, and gas that nature started forming 500,000,000 years ago. By comparison, that same fraction of a calendar year is approximately 30 seconds.

8.(c) More than a third of the world's energy is consumed by the 6% of the world's population residing in the United States.

9.(c) Natural gas reserves in the U.S. are expected to be exhausted in about 40 years. Petroleum should last for less than a century. Coal, 500 years or so, if used at the present rate of consumption. (The consumption rate of coal is expected to increase rapidly, so coal will probably be used up in about a century.)

10.(b) For more than a century, American demand for energy has doubled, on the average, every 20-25 years. Now, the rate is doubling in less time.

WHAT'S YOUR E.Q.?

How much do you know about energy? What's your Energy Quotient? To find out, read each statement. Find its correct answer. Then write the number of the answer in the blank.

A. Slows the movement of heat. _____

B. Recommended home temperature in winter. _____

C. Open and close it quickly. _____

D. A quick shower uses _____ the water of a normal bath.

E. Put it around windows and doors. _____

F. Maximum temperature for water heater. _____

G. Insulated drapes can block out _____ of the heat from the sun.

H. Look for it on an air conditioner. _____

I. What cooking pan needs on top. _____

J. Heat Pump. _____

K. Using the range oven for a heater or toaster is a _____ of energy.

L. Should be flat-bottomed. _____

M. Air condition at _____.

N. Clean it after each dryer load. _____

O. Solid-state appliances use _____ energy than tube types.

P. Vent it to the outside. _____

Q. Heating and cooling system _____ should be cleaned or replaced every 30 days.

R. Fluorescent lights are at least _____ times more efficient than incandescent lights.

S. Clothes washers and dishwashers are most efficient when washing _____ loads.

T. Small appliances are _____ users of energy.

1. Clothes dryer
2. Lint Zephyr
3. 50 Percent
4. Pots and Pans
5. Insulation
6. More
7. Wasteful
8. 75 degrees
9. 3½
10. 66⅔
11. 65 degrees or lower
12. A high EER
13. Plastic
14. 1/32 inch
15. A tight-fitting lid
16. 200 percent heating efficiency
17. 170 degrees
18. 150 degrees
19. Lint filter
20. Wise
21. Filters
22. Full
23. Refrigerator door
24. Efficient
25. 78 degrees or higher
26. Less
27. Caulk
28. Rotors
29. Half
30. One-third

TEACHER'S ANSWER SHEET

WHAT'S YOUR E.Q.?

Statement Letter	Correct Answer	
A.	5	Insulation
B.	11	68 degrees
C.	23	Refrigerator door
D.	29	Half
E.	27	Caulk
F.	18	150 degrees
G.	3	50 percent
H.	12	A high EER
I.	15	A tight-fitting lid
J.	16	200 percent heating efficiency
K.	7	Wasteful
L.	4	Pots and Pans
M.	25	78 degrees or higher
N.	19	Lint filter
O.	26	Less
P.	1	Clothes dryer
Q.	21	Filters
R.	9	3½
S.	22	Full
T.	24	Efficient

Scoring:
20, 19, 18 correct answers-Energy Conserver, First Class
17, 16, 15 correct answers-Energy Conserver, Second Class
14, 13, 12 correct answers-Energy Conserver, Third Class
11, 10, 9 correct answers--Energy Conserver, Fourth Class
Below 9-Go back to basic training

Title: Where Has All The Fuel Gone?

Purpose: To examine energy usage in various modes of transportation

Concept: Energy is a fixed commodity being neither created nor destroyed but converted from one form to another. The means of conversion and the by-products of this conversion are important.

Procedure:

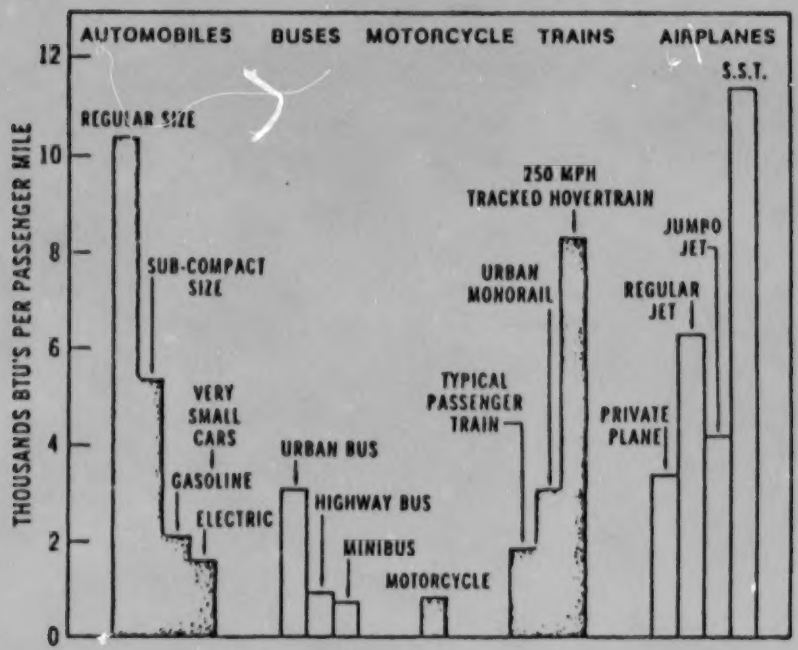
1. Present to the class the graphed data gathered in 1972 (shown on the next page) entitled "Transportation Energy Consumption of Various Modes."

2. Divide the class into four groups entitled (1) automobiles, (2) buses, (3) trains, and (4) airplanes. Assign each group the responsibility to examine carefully the data concerning the efficiency of various vehicles within their mode of transportation. Each group also should compare the efficiency of their mode with the other three.

3. Each group should select a spokesman or two who will explain, as clearly as possible, why certain vehicles in their type of transportation are more energy consumptive than others. The spokesman also should report and defend the group decision as to whether "their type" of transportation should increase or decrease in the years ahead.

4. Have students research present energy consumption of various modes of transportation. Compare the 1972 data with present information. Discuss changes and reasons for differences in consumption.

TRANSPORTATION ENERGY CONSUMPTION OF VARIOUS MODES



	MODE	PASSENGER MILES PER GALLON	NUMBER PASSENGERS	THOUSANDS BTU'S PER PASSENGER MILE
Autos:	Regular Size	12	1.3	10.4
	Sub-compact	23	1.3	5.4
	Very Small (gas)	59	1.3	2.1
	Very Small (elec.)	78	1.3	1.6
*Buses:	Urban bus	40	12	3.1
	Highway bus	140	22	0.9
	Minibus	175	7	0.7
*Motorcycle:	(2 HP)	160	1	0.8
*Trains:	Passenger Train	65	300	1.9
	250 mph Tracked Hovertrain	15	48	8.3
	Urban Monorail	40	20	3.1
*Planes:	Private plane	37	3	3.4
	Regular jet (DC-8)	20	80	6.3
	Jumbo jet (B-747)	30	200	4.2
	S.S.T. (Mach 2.7,U.S.)	11	150	11.4

*Source: Rice, Richard A., 1972, "Energy Efficiencies of the Transport Systems"; a paper presented before the Society of Automotive Engineers at the International Automotive Engineering Congress, Detroit, Michigan, January 1973.

Title: Energy And Matter

Purpose: To help develop an intuitive notion of energy by directing the students' attention to a variety of changes happening to many objects and to look at the effects of these changes

Objectives: Students should be able to:

1. Discuss the effects of energy in action.
2. Recognize and give examples of electrical, heat, chemical, and mechanical energy.

Materials:

Electric hot plate
400 ml Pyrex beaker half full of water (or use sauce pan)
Electric hair blow dryer. Tape thin strips of cloth or plastic over it so that they will stream out in front of dryer.
Flashlight and batteries
Two fruit juice glasses; one containing a small amount of (5-10 ml) baking soda; the other (5-10 ml) of vinegar.
Candle (or oil lamp)
Bucket of water or sink
Battery-operated electric bell
Meter stick
Two chalk erasers
Book
Coin

Procedure:

The main focus of this lesson is to have students observe each of the six demonstrations on the next page, record what they see, and tell what is happening and why.

Except for the first demonstration, discuss and operate the other demonstrations separately. Begin by having a student volunteer to plug in the hot plate. Ask the students to look at the water in the beaker occasionally, and to raise their hand when they see something is beginning to happen.

Move on to the second demonstration in the meantime, and so on. However, when someone notices ask: What is happening and why? (Electricity makes the plate hot; heat makes the water boil.) Allow the water to continue to boil until there is a noticeable lowering of the water level. At this time ask: What has happened to the missing water and why? (Electricity made the plate hot; heat changed the water to steam; and steam went into the air.)

DEMONSTRATIONS

1. Ask a student to plug in the hair dryer. What is happening and why? (Electricity causes the motor to turn the fan. Fan blades push the air. This moving air causes the streamers to move.)

2. Visibly assemble batteries in the flashlight and turn on the flashlight. What happened and why? (Batteries - cells - made electricity, and electricity made light.) You may want to add that the filament got hot, or not mention it at this time. What would happen if there were no batteries in the flashlight? Would it light? Why?

3. Pour vinegar into the glass containing baking soda. What is happening and why? (A chemical reaction takes place and gas CO_2 is given off - it is what bubbles up.)

4. Light the candle or oil lamp wick. What happened and why? (Wax - oil - burned producing heat and light.) It may be necessary to call attention to the fact that the wick or string is not the burning element.)

5. Connect bell to battery. What happened and why? (Battery produced electricity and the electricity produced a changing magnetic field which moved the bell clapper making the ringing sound.) What would happen if the clapper wasn't connected to the bell? (Nothing.)

6. Drop an object such as a book on a teeter-totter arrangement of meter stick and erasers. Ask: What happened and why? (Falling object made the stick move which pushed the eraser into the air.)

Optional Activity

With more advanced classes, ask students to set up the demonstrations, previously outlined, in student activity centers. In each center, two or three students set up the energy-in-action mini-lab and introduce the energy concepts to their classmates, who travel from one center to the next. Have center leaders prepare worksheets to hand out ahead of time. These sheets may include a drawing of the object to be observed and sufficient space for students' notetaking.

Title: Energy And Matter

Purpose: To study the conversion of plant materials into coal

Concept: Energy is a fixed commodity being neither created nor destroyed but converted from one form to another. The means of conversion and the by-products of this conversion are important.

Materials: Ferns, slides or diagrams of tree ferns, sand, peat moss, coal, 10 gallon aquarium, slides or charts of geologic time

Procedure:

1. Distribute to the students samples of ferns, peat, and coal. Show students geologic time charts and describe the physical condition of the earth during the coal-forming processes.

2. Fill a 10-gallon aquarium with tap water. Add enough peat moss to make a one-inch layer. Allow one week to elapse. What is the condition of the water now? (Include pH, odor, turbidity, decomposition of peat, etc.) Have any changes occured in the peat? Suggest reasons for the changes, or explain why changes did not occur.

3. Sift moderately fine sand over the peat to a depth of one inch. After the sand settles, add an equal depth of peat. Repeat the process for as long as desired, or until several successive layers have formed. Is coal still being formed today naturally? Explain.

4. Have students go to the library and research the formation of coal, the types of coal, and the locations of coal deposits.

5. Ask the students (using topographical maps) to locate the coal-producing areas in the United States. Find cross-sections of the area and locate a coal vein. Would the cost of extracting the coal be feasible and practical?

Title: Energy And Matter

Purpose: To examine changing patterns of energy use

Concept: Energy is a fixed commodity being neither created nor destroyed but converted from one form to another. The means of conversion and the by-products of this conversion are important.

Procedure:

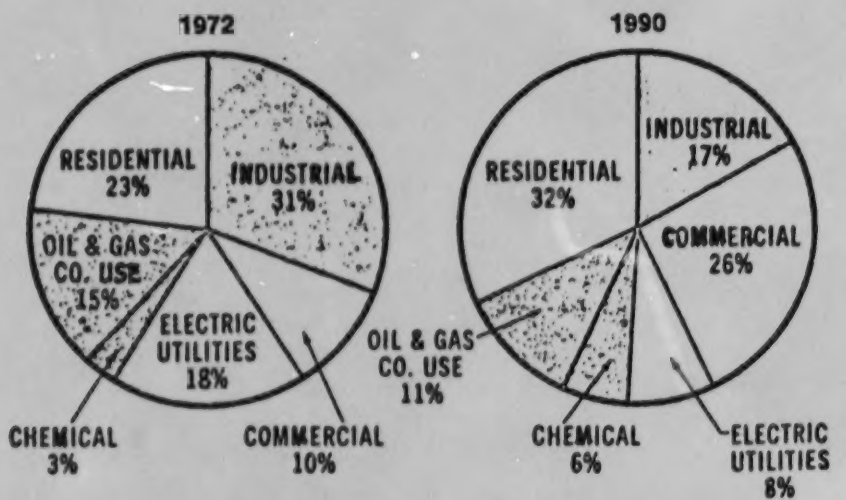
1. Present to the class the pattern of natural gas use in the U.S.A. in 1972 and the projected uses of this source of energy in 1990 as reported below by the Shell Oil Company.

2. Research gas consumption patterns at this current time. Your local utility company can assist you.

3. Ask for volunteers or divide the class into six groups and assign the homework or library research task of finding as many specific examples as they can of how natural gas is used in the residential, industrial, commercial, electric utility, chemical and oil and gas markets.

4. Share the findings in a subsequent class meeting. Try to analyze why some markets will be increasing and others decreasing their use of natural gas between now and 1990. What energy resources will be substituted in the industrial and electric utilities markets for diminishing supplies of natural gas?

GAS CONSUMPTION BY MARKET



Courtesy of Shell Oil Company

Title: Energy And Matter

Purpose: To calculate energy equivalents of household trash

Concept: Energy is a fixed commodity being neither created nor destryoed but converted from one form to another. The means of conversion and the by-products of this conversion are important.

Procedure:

1. Review with the class the general principle that energy is required to make all of the substances we throw away in our trash cans. Review also the principle that recycling materials generally requires less energy than making new products from raw materials. Indicate that energy savings can be calculated in KWH of electricity, BTU's, gasoline equivalents, and in other units.

2. Present, with use of an overhead projector or duplicated hand-out, the information below that shows gasoline equivalents of various substances thrown into trash cans annually by the average American household.

3. What substances are most prominent? What surprises, if any, are noted? How much potential saving of energy (gasoline equivalents) could be obtained from the number of families represented in the classroom? By the number of families in your county or city? Why aren't we moving more rapidly to save energy by recycling? Would anyone be hurt by such moves?

SUITABLE FOR RECYCLING:		GASOLINE EQUIVALENTS
Newspapers	233 lbs.	11.2 Gallons
Other Separable Paper	173 lbs.	8.3 Gallons
Glass	368 lbs.	3.7 Gallons
Ferrous Metal	210 lbs.	10.1 Gallons
Aluminum	20 lbs.	16 Gallons
Separable Plastic	33 lbs.	5 Gallons
Other Metal	7 lbs.	
NONSEPARABLE ITEMS		
Rubber, Leather	33 lbs.	1.4 Gallons
Textiles	33 lbs.	1.4 Gallons
Wood	20 lbs.	.9 Gallons
Plastics	77 lbs.	3.4 Gallons
Paper	370 lbs.	16.3 Gallons
Food Waste	593 lbs.	26.1 Gallons
Misc. Inorganic	33 lbs.	
YARD WASTE	600 lbs.	19.2 Gallons

Title: Move Like Something

Purpose: To study the school bus system

Objectives:

1. Students will know the number of buses required to transport a given number of students to and from school.

2. Students will know the amount of gasoline required by the day, week, or month and its cost.

3. Students will know the combined and average weight of the people carried on the buses.

4. Students will consider the advantages and disadvantages of busing compared to other modes of transportation.

Materials: pencil and paper, bathroom scale

Procedure:

1. Obtain permission from the transportation section of your school district to carry out this activity.

2. Find out how many buses your district uses each day and obtain a map showing all bus routes.

3. Assemble materials.

4. Tell the students that answers to several questions will be determined, including: How many buses move how many people each day? How many miles? How much gasoline is used? What is the combined weight of the people moved? When the gasoline is added up and the number of pounds of people is determined, how does the result compare to other modes of transportation such as private automobiles, bicycles, trains, and airplanes per cost-effectiveness in moving sheer weight around? Are there social factors influencing the mode of transportation chosen, e.g., busing? What is the total length of all the bus routes?

5. Divide or let students self-select working groups.

6. Explain to students that the purpose is to trace the school bus system in their district, determine bus mileage, and gasoline cost.

7. Encourage students to work out their own objectives and methodology. Some points you may want them to consider include:

   a. Will one group be assigned to each bus? (This will depend upon the total number of buses in your system. You will probably want to get this number when calling for permission.)

   b. Will some groups wish to find out from the school planning office what they believe to be the miles traveled?

   c. Will groups want to check actual odometer readings?

   d. How can they determine how much gasoline is being used? Where does the district obtain its gasoline? What type (no-lead, ethyl, regular, diesel) is used? What is the cost per gallon? Will students want to keep a log of gallons for each bus (or can the district make this available)?

   e. Could the miles traveled be figured out simply by tracing the bus routes on a map? (The actual number of miles might be difficult, but by tracking each route with string and comparing the length of the strings, a quick comparison of the length of routes can be obtained.)

   f. Have students make a map of the bus system to put on the bulletin board. Compare it to the district map if one is available.

   g. Allow students necessary time to obtain their data. If you are taking odometer readings, you might need to take a few minutes in the morning for readings on several successive days. Students who plan to research by asking planning officials will have to contact them.

9. How many people are carried? Do you want to count each bus? Is it easier to ask the planning office? It would probably be better for students to do the research and then check their data with the planning office if they want to see how the figures compare.

10. Have students compile their data by drawing maps and graphs.

11. Have students obtain an average weight by weighing each person in the room and calculating the average. Multiply that by the number of people who ride the bus system. Compute the cost of the gasoline to transport the average number of people on a bus of that given poundage. Compare with other modes of transportation, as given on the graph. Ask students if their system comes close to the average given for bus systems. If it does not, ask them what the reasons might be.

Title: Move Like Something

Purpose: To discover the relationshp between energy and movement

Materials: 250 ml beaker, water, thermometer, small rubber ball, water

Procedure:

1. Obtain one 250 milliliter beaker and fill with 250 milliliters of water. Pour this into a liter beaker and measure the temperature of the water in Celsius degrees. Place one hand into the liter beaker for five minutes and measure the rise in temperature in Celsius degrees. This result will be T_1.
2. Take a small rubber ball that will fit within the grasp of your hand and continue the experiment for five more minutes, but this time squeezing the ball while your hand is immersed in the water. Record the temperature of the water after the five minutes of exercise. This temperature is T_2.
3. Subtract T_1 from T_2 or $T_2 - T_1 = T_f$ or the final number of degrees change in temperature of the water.
4. Repeat the exercise with ten persons and average the results.
5. How many calories of energy were used in the ball squeezing? (To figure this, remember: one calorie equals one gram of water raised in temperature one degree Celsius. Since one gram of water is approximately one milliliter, then 250 ml. equals 250 grams).
6. If we replaced your hand with an electric coffee or tea heater could you figure the amount of energy required to raise the temperature the same as your hand exercise (electrical energy to heat energy in watts)?

PHYSICAL EXERCISES AND HEAT ENERGY CHART

	Student Name	T_1 Temperature	T_2 Temperature	T_f Change	Calories Used
1.					
2.					
3.					
4.					
5.					
6.					

Junior High all averaged ball squeezing for five minutes = 312.50 calories

Total divided by 6

Sum Average for Exercises _____ Calories

Title: What's In A Barrel Of Oil?

Purpose: To understand that many products result from the distillation of crude oil (Distillation is presented as a process of boiling and condensing.)

Objectives: Students should be able to:
1. Name several common products resulting from the refining of crude oil.
2. Identify distillation with boiling and condensing fluids.
3. Identify the steps on refining crude oil.

Materials: Samples of crude oil, gasoline, kerosene, light oil (household), heavy oils (car oil), grease, wax. These should be placed in clear plastic jars with caps on them. All containers should be filled about half full, and each should be labeled. CAUTION: All these materials are flammable. Make sure there are no open flames in the room.

Procedure:

1. Have students examine each sample for such characteristics as color and degree of thickness. Allow students to handle the containers. Then list the characteristics of each.

2. Call attention to the crude oil sample. Do you see all the others in this jar?

3. Have students make a list of petroleum products. Use a chart to classify these products. (Clothing, Fuels, Toys, Supplies)

4. Make a report on the petro-chemical industry. Have students include actual samples of petro-chemical products as part of their reports.

LOOKING AT OIL AND OIL PROUDCTS

Use the chart below to classify the oil products.

	Color	Thick or Thin?
Crude Oil	_____	_____
Gasoline	_____	_____
Kerosene	_____	_____
Light Household Oil	_____	_____
Car Oil (Heavy Oil)	_____	_____
Grease	_____	_____
Wax	_____	_____

Title: What's In A Barrel Of Oil?

Purpose: To evaluate the characteristics of selected fuels

Background Information: Presently, most of our energy requirements are met through using fossil fuels. However there are other alternative sources of energy such as solar, wind, fission, fusion, hydrogen, hydro, or geothermal which must be considered and developed.

Procedure:

1. Say: The characteristics of "good" energy resources are sometimes listed as follows:

   a. High energy potential
   b. Abundant supply available
   c. Relatively easy to obtain
   d. Relatively easy to convert the energy source into useful work
   e. Extraction and use of the energy source should not have negative environmental effects or in any other way pose threats to health.

2. Say: Some energy sources are high (+) in some of these characteristics but low (-) in others.

3. Divide the class into groups of three or four students. Have them rate (+, 0, or -), several fuels using the characteristics listed. Common energy resources such as coal, petroleum, natural gas and wood should be rated. It might be interesting to include other fuels seldom used in the U.S.A. such as peat, alcohol, dried cow dung and others.

4. Pool group judgments to determine areas of agreement or disagreement. What is the likelihood of our "running out" of the best fuels? What, if anything, can be done about it?

Title: Hydrogen As A Fuel

Purpose: To conduct an experiment producing hydrogen as a fuel

Materials: Dilute hydrochloric acid, mossy zinc, test tubes (2), graduated cylinder or dropping bottles

Procedure:

1. Pour 5 ml of dilute HCL over a small piece of mossy zinc in a test tube. (SUPERVISE CAREFULLY)
2. Collect the gas in the other test tube, and then test the gas with a burning splint.
3. Try other materials. Pour over copper, iron, magnesium, lead...
4. Record results.

Title: Burning

Purpose: To understand how to find the energy content in wood

Materials: (per group) 1 small cardboard juice can with metal bottom, I large juice can, 1 ring stand with clamp, 100 ml water, wire screen, 1 thermometer, 1 platform balance, 1 glass stirring rod, wood shavings (different kinds), graduated cylinder, matches

Procedure: (Note: See diagram on next page.)

1. Cut a piece of screen wire as shown in diagram. Bend the legs of the wire down and the sides up - this will prevent the wood shavings from falling off.

2. Weigh 2.75 grams of wood shavings and carefully place them on the wire basket. Set 2 match heads in the wood shavings. (for easy lighting)

3. Punch 2 holes in the sides of the small juice can near the top rim. Put the glass stirring rod through these holes. Attach a ring stand as shown in the diagram.

4. Measure out 100 milliliters of water. Put it into smaller can (1 ml of water = 1 g or .001 kg). Record on data sheet. Take the temperature of water before heating. Record data.

5. Punch a couple of holes in the side of the large can near the bottom Remove the bottom from the large can. Ignite the wood shavings and quickly place the larger can over the burning wood shavings.

6. Lower the small can into the larger can using the ring clamp.

7. Measure the temperature of the water after heating. Record data.

8. Record the change in the temperature of the water on the data sheet. Specific heat of water = $\frac{1 \text{ calorie}}{1 \text{ gram } 1^{\circ}C}$

9. Multiply the temperature change x the mass of the water x .001 to get the heat gained by water. Record on data sheet. (The .001 is for changing grams x Celsius to Calories.)

13. Find the heat content of wood. $\frac{\text{heat output}}{\text{mass of wood}}$ Record.

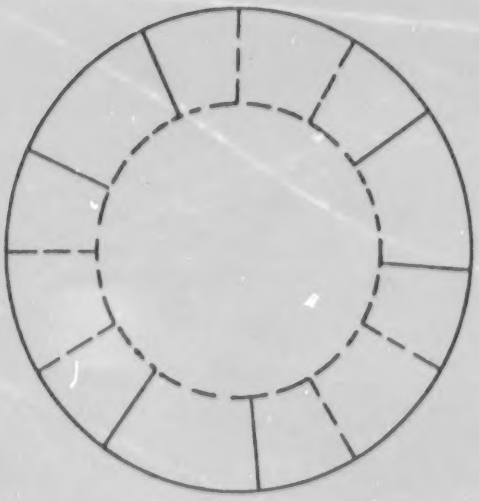
14. An approximate value for the heat content of wood is 1250 Calories/lb or 2.76 Cal/g. This is the accepted standard.

15. How do your experimental results compare with the accepted value of wood? Percent difference = $\frac{\text{experimental results}}{\text{accepted value}}$

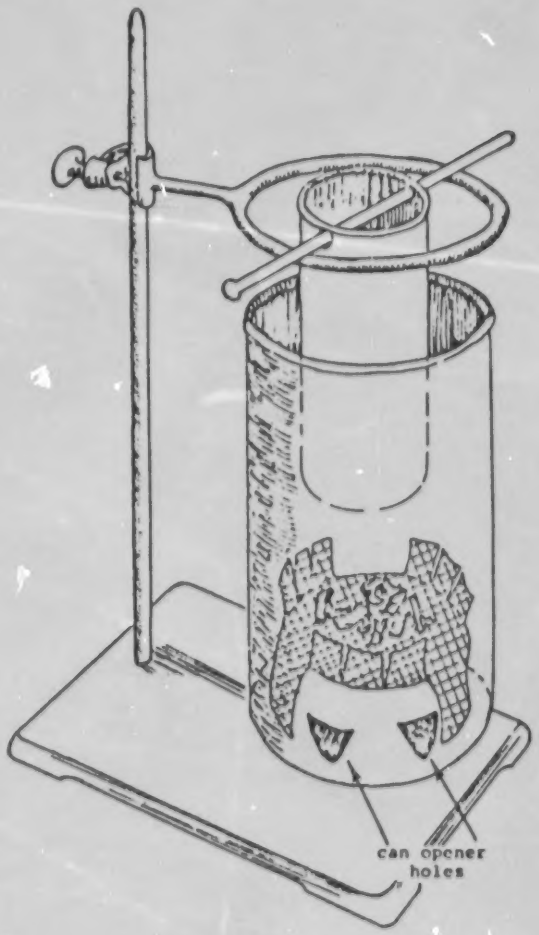
LAB ACTIVITY DATA SHEET

1. Mass of water
2. Mass of wood shavings
3. Temperature of H_2O before heating
4. Temperature of H_2O after heating
5. Temperature change of H_2O
6. Heat gained by H_2O = temperature change x mass of H_2O x 1 Cal/g-c°
7. Heat content of wood = $\frac{\text{heat output}}{\text{mass of wood}}$
8. Percent difference = $\frac{\text{experimental results}}{\text{accepted value}}$
9. Why was your value probably lower than the average value for wood?
10. How might you improve the design of this experiment?

Screen Wire



Note: Cut along solid lines



Title: Greenhouse Effect

Purpose: To build a solar greenhouse

Materials: Corrugated cardboard (amount needed determined by drawings), clear plastic, 3 or 4 mil, 50 cm x 450 cm (local hardware of garden stores), flat black spray paint, white spray paint, 2 thermometers, plastic wrap (grocery store), tape, string or thread, tin cans, rubber bands, insulation material (styrofoam, cardboard, newspaper, etc.)

Procedure:

1. Build a solar greenhouse and a standard greenhouse according to the drawings on the following pages.

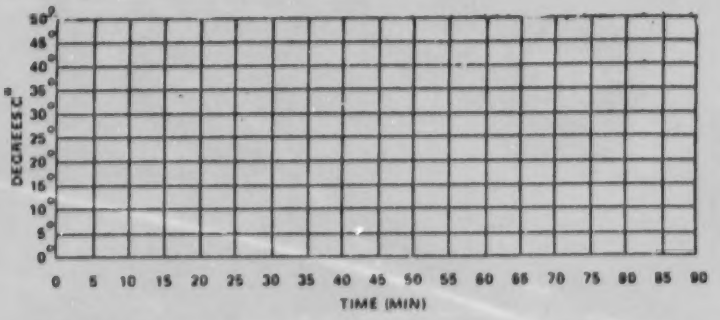
2. Conduct an experiment like this:

   a. Face both greenhouses directly into the sun.

   b. Measure and record the temperatures in each one as the day progresses.

   c. After they have reached a high temperature, place both in the shade. Read and record the temperatures as they cool off.

3. Graph the results of your experience.



4. Other ideas to explore:

   What would happen if you added more insulation material? What if you added 2 layers of plastic to the front?

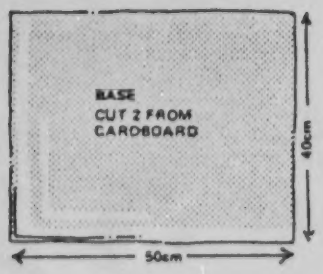
   What are other ways of maintaining and storing heat when there is no sunlight?

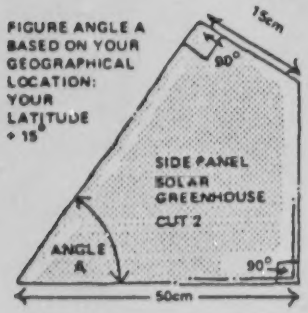
   Try substituting gravel, sand, and soil for H_2O in the tin cans in the solar greenhouse and try the experiment again.

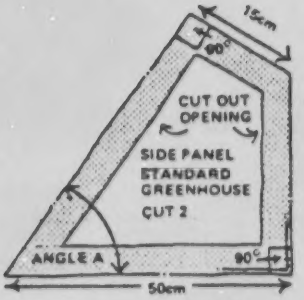
   Would you save energy in your climate by using a solar greenhouse?

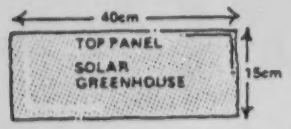
BUILD A SOLAR GREENHOUSE

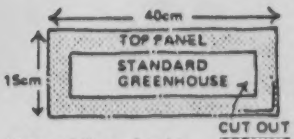
Build a solar greenhouse and a standard greenhouse according to these drawings. (Be sure to cut 2 of each side panel.)



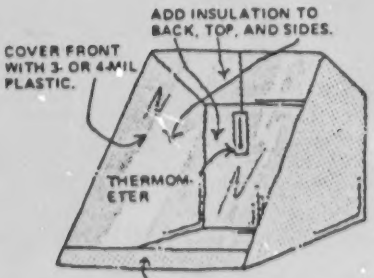








Spray the outside of the greenhouses white before adding plastic.

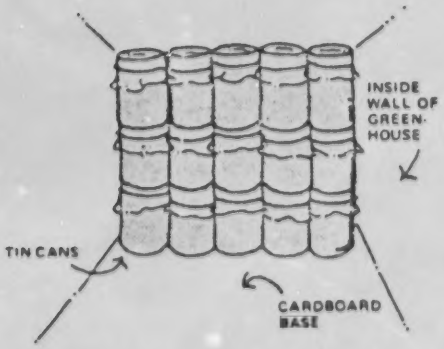


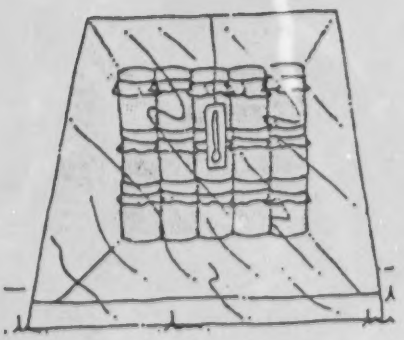
Add 5cm cardboard panel for sta...

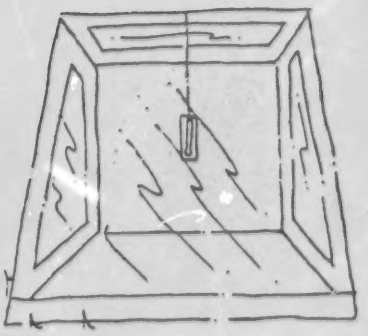
Spray the cans flat black.

Fill with H_2O and cover tightly with plastic wrap and rubber bands.

Stack them in the back of the solar greenhouse.







Title: Move Molecules

Purpose: To construct electrical circuits

Materials: electrical clips, copper wire (coated), flashlight bulbs, dry cell batteries, large nails, saw

Procedure:

1. To construct a simple electrical circuit:

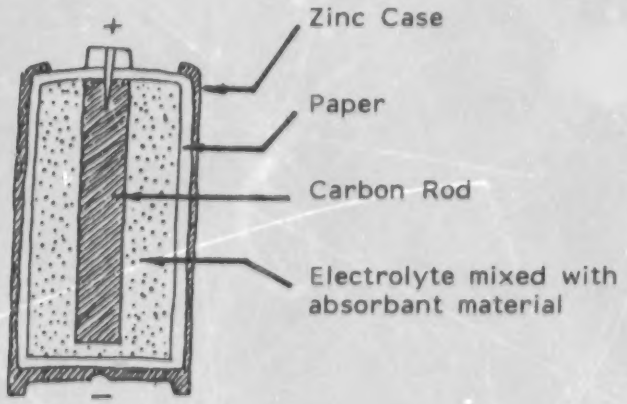
   a. Assemble all materials for students to use.
   b. Divide students into small groups. Distribute materials.
   c. Ask them to try lighting the bulb using two pieces of wire, a battery, and the bulb.
   d. When each group has succeeded in making the circuit, discuss any problems they had.
   e. Using the same set of materials, have students try as many ways as they can to wire three to six bulbs.

2. To recognize and understand the parts of a dry cell:

   a. Distribute an old dry cell battery to the students.
   b. Have students cut the battery in half with a saw.
   c. Ask students to observe:

      - the carbon or positive pole in the center
      - the zinc which is the negative pole
      - the material between the two poles which is the chemical that acts on the plate of the cell. Ask students to notice how the zinc has been eaten away by the chemical and how the chemical materials were sealed into the zinc without pitch.

   d. Ask students to draw a dry cell battery, labeling the parts as in the following diagram.



Title: Man And The Sun

Purpose: To discover which colors absorb the sun's heat the best

Materials: White, black, green, red, and blue construction paper (all the same size), timer, uniformly-sized ice cubes, plastic bags (sandwich size), metric measuring cup

Procedure:

1. Put an ice cube in five plastic bags. Place one bagged cube on top of each of the five colored sheets of construction paper. Which cube melts first?

2. After 20 minutes, measure the amount of water collected in each bag.

3. Ask: Would you get the same results if the paper were on top of the ice cubes?

4. Ask: Does it work faster with the paper on the top or on the bottom?

5. Ask: Would a house with a white roof be cooler than a house with a dark roof?

6. Ask: Would a house with a dark roof be more or less expensive to air-condition in the summertime?

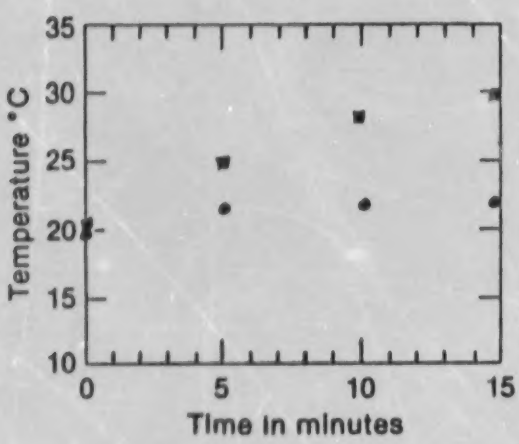
Title: A Clothes "Pole"

Purpose: To determine the differences in temperatures of things in the sun and in the shade

Materials: 2 styrofoam cups, 2 thermometers, watch

Procedure:

1. Pour equal amounts of cold water into 2 styrofoam cups. (The colder the better!)
2. Place a thermometer in each cup.
3. Measure the water temperature in each cup.
4. Set one cup in the sun and the other in the shade.
5. What is the temperature of each after 5, 10, and 15 minutes?
6. Make a graph like the one below, and use it to record the temperatures for 15 minutes. Use different colors for each cup.
7. Would the water in the cup get warm on a cloudy day? On a cold, sunny day?



8. Can a house be heated by solar energy if it is shaded by a big tree? (Discuss placement of trees: north; south; east; west sides of house - as they relate to solar energy.)
9. What happens to the water in a hose if it lies in the sun all day?
10. What is the difference in temperature of the ground in the shade and in the sun?

Title: Who Needs Appliances?

Purpose: To have students think about their energy use

Procedure:

1. Have students list 12 major appliances used in their homes regularly.

2. Say: If there were a law that said you had to use less electricity, draw a pencil line through the three appliances in your list you could do without.

3. Have students circle in pencil the three that really mean the most to them and that they would hold on to until the very end.

4. Say: Now look back over your list and your decisions and consider:

   a. Why did you decide to do without the three items?

   b. Why did you want to keep the other three?

5. Have students list some efficiency steps they can take to reduce the energy and money consumed by each of the three appliances they would hold on to until the very end.

Title: Synthetics

Purpose: To increase students' awareness of synthetics in relation to their lifestyle

Procedure:

1. Have students assemble various kinds of equipment and articles of special clothing used to play sports or in physical education classes.

2. Determine which of the balls, bats, ropes, gym suits, shirts, uniforms, etc., are made of synthetics or part synthetic.

3. Discuss how and of what materials these pieces of equipment were made before synthetic materials were developed.

4. Discuss how and of what materials the articles of clothing were made before synthetic materials were developed.

5. Discuss effects of the discovery of synthetics on sports equipment development and use.

6. Divide class into two gropus. (Before and After)

7. Have students prepare presentations to compare BEFORE SYNTHETICS and AFTER SYNTHETICS. You might wish to have each group make posters, etc., to illustrate before, after.

8. Have students make presentations.

Title: Gasoline Rationing - Why Not?

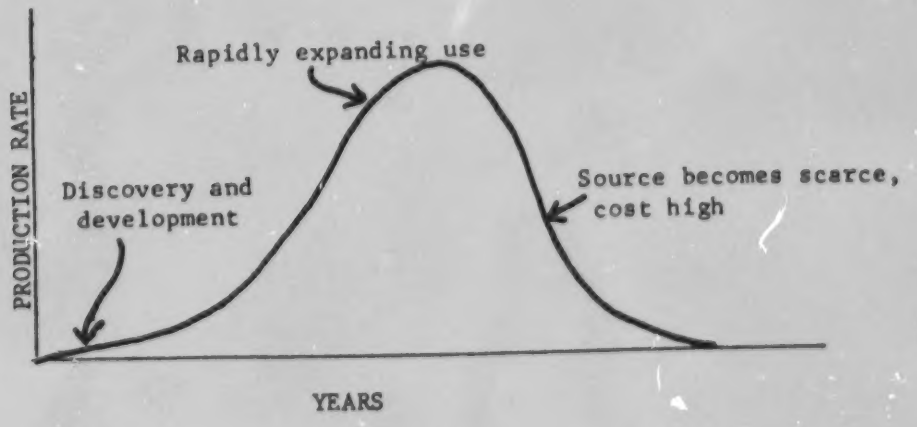
Purpose: To study the world's supply of depletable natural resources

Concept: The production and distribution of energy have environmental and economic consequences.

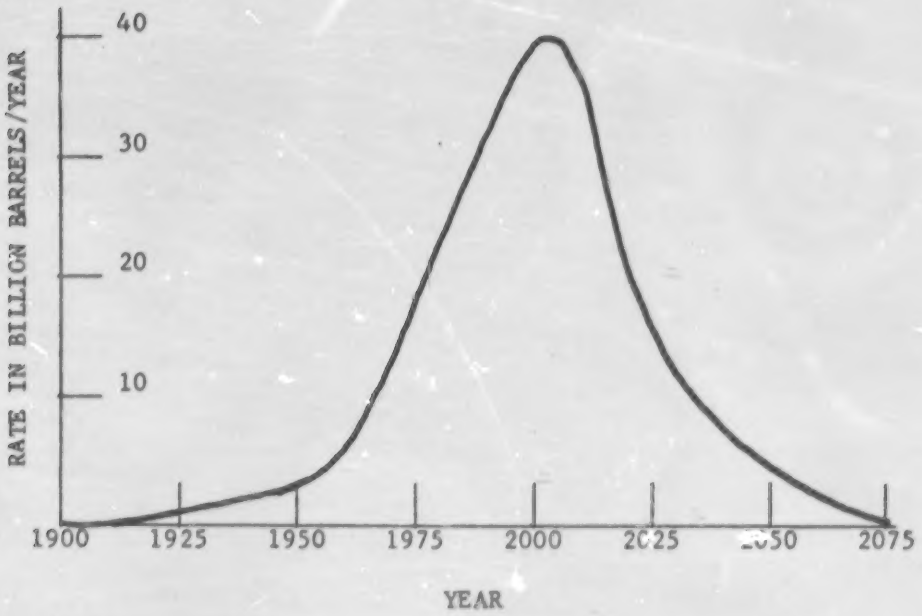
Procedure:

1. Say: Energy is that quality that allows or causes change, force, work, movement or heat. The results of energy can be measured and its effects felt. Many people falsely assume that energy will be available forever. The world's supply of natural resources, especially those which go into the creation of energy, are not limitless. Energy producing resources are being used at an ever increasing rate by the affluent nations of the world. Until recently, very little thought or attention has been given to what will happen when the raw materials needed to produce energy become scarce and ultimately depleted. The United States has only a small fraction of the earth's population, but consumes more than one-third of the earth's annual output of natural resources to produce the goods and services represented by our present standard of living.

2. Draw the graph below on the chalkboard. This graph represents the life span of a depletable resource.



3. Draw the following graph on the chalkboard and explain that this graph represents an optimistic view of the life span of the world's oil resources.



4. After studying both graphs, have students answer the following questions.

   a. When did the discovery of the use of oil for producing energy occur?

   b. What is happening today in regard to the use of oil as an energy producing source?

   c. How many years do we have left before our natural resource above is depleted?

   d. From the available literature obtain data adequate to construct a graph showing the life span of another energy-producing natural resource such as natural gas, uranium, or coal.

5. Have students discuss this question: Do you feel that it is fair for a country the size of the United States to use perhaps as much as thirty times the amount of nonrenewable resources per person as another smaller underdeveloped country? Give reasons to support your answer.

Title: Gasoline Rationing - Why Not?

Purpose: To understand the energy savings related to using returnable bottles

Concept: Energy, its production, use, and conservation are essential in the maintenance of our society as we know it.

Procedure:

1. Review with the class the fact that energy can be saved by using returnable bottles instead of throw-away soft drink bottles. The amount of energy saved is paraphrased as follows:

   "The purchase of a six-pack of soft drinks in returnable bottles instead of no-deposit, no-return containers will save the energy equivalent of 1½ pints of gasoline. The saving of 1½ pints of gasoline can take the average family car about 2½ miles. Additionally, when the empty bottles are returned for the 30-cent deposit the six-pack purchase will have cost 18 cents less than for throw-aways."

2. Involve the class in some mathematical computations. How much energy equivalent in gasoline will each family represented in the class save if they purchase one or two six-packs of soft drinks in returnable bottles instead of nonreturnable bottles each week for one year? How many miles of automobile travel are possible? How much money is saved? What are the total amounts for the entire class?

3. Discuss: Since this appears to be such an easy way to save energy, why do we still find so many persons buying beverages in throw away containers? What, if anything, might or should the government or people do about this matter?

Title: Gasoline Rationing - Why Not?

Purpose: To develop and apply criteria for allocating limited energy supplies

Concept: Energy, its production, use, and conservation are essential in the maintenance of our society as we know it.

Procedure:

1. Discuss: It is quite conceivable in the years ahead that a local community might find its energy supply (gas, gasoline, electricity) curtailed significantly. Under these circumstances, which energy consumers should be given highest priority?

2. Divide the class into groups of three or four students. Ask each group to develop criteria they deem appropriate to apply in making priority decisions for energy usage.

3. Ask each group, also, to identify major and/or critical energy users in the local commuity such as homes, schools, industries, hospitals, power plants, police, firemen, water systems and so forth.

4. Finally, ask each group to apply their criteria to their identified energy users and designate priorities. Determine concensus and areas of disagreement as each group reports to the class.

5. What options other than the possibility of arbitrary priority allocations are available to the American people?

Title: Obituary To A "Gas Guzzler"

Purpose: To discover the relationship between energy supplies and automobile engine efficiency

Materials: Shoe boxes, spring scales, blocks of wood (or books)

Procedure:

1. Have students design experiments using the listed materials to compare how much energy it takes to pull a heavy object as compared to a lighter object. (Punch a hole in the box and attach the spring scale.)

2. Develop other ideas:

    a. Making models - different shapes (aerodynamics)
    b. Going up inclines
    c. Going into a wind; with a wind

3. Record grams of force required.

4. Ask: How would this experiment relate to the comparison of a large luxury car to a small car?

5. Develop other questions, comparisons and experiments.

Title: Energy Ads

Purpose: To have students identify eight major advertising ploys, apply this knowledge in determining how advertisements make cars attractive, and be able to identify all eight ploys in ads

Materials: Brochures from car manufacturers; LET THE BUYER BEWARE (next pages, reproduce for handout)

Procedure:

1. Instruct students to read LET THE BUYER BEWARE. Tell them to keep in mind while reading that they should try to think of ads that sell each of the hidden needs. Have students describe the selling technique and give an example of an ad that represents the ploy.

2. After the students have read the materials, meet as a class to:

   (a) Briefly summarize the "needs" and give examples.
   (b) Discuss the difference between needs and desires. Ask students if they think the eight hidden needs are needs or desires.
   (c) Relate emotional reactions to the article -- how the assumptions of the motivational researchers made them feel (angry, defensive, manipulated, silly, etc.).
   (d) Probe to find out if the students think motivational research can really determine hidden needs, and how they feel about being manipulated to buy things.
   (e) Discuss the ethics of advertising (playing on feelings of insecurity, powerlessness, or worthlessness; encouraging impulsive and irrational buying; developing a public attitude of wastefulness towards natural resources by encouraging psychological obsolescence of useful items).

3. Ask for ideas on which "needs" might be used to sell cars. Ask them to recall examples of car ads (on TV or in magazines) that have used any of these techniques.

4. Then distribute car ads and magazines. Instruct students to analyze the ads for:

   (a) the eight hidden needs
   (b) the selling points used by manufacturer (draw on ideas generated in "The Dream Machine," such as the characteristics of cars, e.g., gas mileage, custom interior, sporty styling, etc.).

5. Results can be shared orally or presented for display in written form.

LET THE BUYER BEWARE

In the early 1950's, the advertising business changed a great deal. Companies began to make use of psychology. They hired specially trained people to help them find out answers to questions like these:

1. Why do people buy certain brands?
2. How can advertising affect their choices?
3. What features of a product make it sell better than others?
4. What features in an ad can make a product sell?

Vance Packard wrote a book on this topic, called The Hidden Pursuaders. He found out that advertising can affect our lives in many ways. It can make us buy things we don't want or need and things we can't afford. It can even make us buy things that are bad for our health.

The study of what makes us buy things is called motivational research (or M.R.). M.R. found eight ways to make things sell. These eight ways are used in advertising and are based on human needs.

1. Selling emotional security

Many times we buy things to make us feel secure. For example, buying a freezer costs quite a bit of money. In addition, it adds to the electric bill. And, it does not always prevent the wasting of food (do some foods get lost in your freezer?). People are told that having a freezer saves money and are given practical reasons for owning a freezer. However, M.R. found out something interesting. They found out that people who feel insecure need more food around than they can eat. They decided that most people who buy freezers are buying "emotional security."

2. Selling reassurance of worth

In the 1950's, a study was made in Chicago about laundry soap. People surveyed showed no brand loyalty. The study concluded that the soap industry's advertisements were old-fashioned. The researchers said that people do not just want a soap that keeps things clean and protects their skin. Because people want to feel that their work is worthwhile and important, the soap industry should foster a feeling of worth and esteem. The soap industry should sell a "reassurance of worth."

3. Selling ego-gratification

This selling method is similar to selling reassurance of worth. Certain publishing companies bring out books that are completely paid for by the authors. The company arranges luncheons, autographing parties in local stores, and newspaper reviews. This makes the author feel important and satisfied. In fact, many will mortgage their homes to pay the cost of publishing; one man even offered to sell his 150-acre ranch in New Mexico. The author was willing to sell his property to buy "ego gratification."

4. Selling creative outlets

Advertising is frequently aimed at women. This is because they often do the shopping and manage the money. In the 1950's before many women began working outside the home, many ads were made for "the average housewife."

In those days, cake mix packages had directions which said, "Do not add milk, just add water." But, many women wanted to add their own creative touch. So, they would add milk or eggs and the cake would fail. They would get angry and blame the cake mix. General Mills was told by a person in M.R. to leave something for the housewife to do. This would make them feel good because they would have a "creative outlet."

5. Selling love objects

You are probably familiar with ads that claim their product has built-in sex appeal. Or ads that use beautiful women or handsome men to sell their product. Or perhaps you've seen an ad where a cute child or baby is the center of attention. All of these are examples of how to sell a love object. The idea behind this type of advertising is that if you use or buy a certain product you will be as lovable or sexy as the person in the ad. Car ads, cigarette ads, and toothpaste ads are especially notorious for this ploy.

6. Selling sense of power

Americans like to buy products that extend their sense of power. M.R. says that the need for a sense of power is particularly strong in men. This has been exploited by companies that sell boats. Although owners of pleasure boats are not going anywhere in a hurry, Americans prefer motorboats to sailboats by eight to one. Motor boats are a way to fill the need for personal power. This need is so strong that people who have owned many boats will buy a more powerful one each time. Selling motorboats is a way to sell a "sense of power."

7. Selling sense of roots

The makers of a popular brand of wine wanted a way to make their wine sell and hired people in M.R. to assist them. Research showed that people relate wine to family-centered or festive occasions. So they decided to develop an ad to take advantage of this. One of their slogans was: "The good old days - the home sweet home wine - the wine that grandma used to make." The result of these carefully "motivated slogans" was a doubling of sales for this wine. The company soon was spending $2,000,000 just for advertising. They used their ads to sell "a sense of roots."

8. Selling immortality

The life insurance business is now a multi-million dollar industry. In 1955, a group of salesmen met to decide how to sell insurance. M.R. helped them find out the hidden desires of people who buy life insurance. They found out that the appeal of life insurance is that it makes people feel they can live forever. Life insurance enables the breadwinner to control the family even after death. Therefore, ads were used which pictured the breadwinner as the hero. His or her thoughtfulness is responsible for a happy, secure family and sells a sense of immortality.

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Title: My Community Sees The "Crisis"

Purpose: To determine the attitudes of students in relation to energy

Materials: Copies of ENERGY ATTITUDE SURVEY

Procedure:

1. Say: Often we are not aware of the attitudes and opinions of those around us. It may be that there are a large number of students in your school who are interested in energy conservation and would make good conservation advocates. Discuss.

2. Using the survey form on the next page and tally sheet below, take a survey of the students in your class or school to determine their attitudes about conserving energy, their role, the government's role, their recommendations and so on. Feel free to add your own questions.

ENERGY ATTITUDE TALLY

Question	Yes Percent	No Percent	Don't Know Percent
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
Additional Questions			

Find the percentages for each response.

Suggestions:

1. You might print your results in the school newspaper.

2. Survey the teachers and administrators. Do their opinions differ much from the students?

ENERGY ATTITUDE SURVEY

1. Do you believe there is an energy shortage? ___yes ___no ___ don't know

2. Do you believe you have been given a realistic picture of the energy situation facing the United States? ___yes ___no ___don't know

3. Do you believe most Americans are energy "wasters"?

___yes ___no ___don't know

4. Do you believe most Americans are energy "conservers"?

___yes ___no ___don't know

5. Do you believe Americans are "spoiled," self-indulgent and reluctant to take responsibility for the future? ___yes ___no ___don't know

6. Do your believe it is the responsibility of every U.S. citizen to conserve energy voluntarily? ___yes ___no ___don't know

7. Do you believe Americans will conserve energy only when government controls are imposed? ___yes ___no ___don't know

8. Would you be willing to reduce your standard of living to conserve energy? ___yes ___no ___don't know

9. Do you believe you as an individual can make an impact on energy consumption? ___yes ___no ___don't know

10. Would you conserve energy to save money? ___yes ___no ___don't know

11. Do you think the money saved is worth the inconvenience of conserving energy? ___yes ___no ___don't know

12. Do you think the energy saved is worth the inconvenience of conserving energy? ___yes ___no ___don't know

13. Do you feel technology will "bail us out" of the energy shortage?
___yes ___no ___don't know

14. Do you feel you have any input or participation in the energy usage decisions made by your family? ___yes ___no ___don't know

15. Are you going to do something to save energy? ___yes ___no
___don't know

Title: I Depend On Others

Purpose: To involve students in using community resources as an integral part of gathering information

Materials: Duplicated copies of the diagrams Electrical Power and Power Plant (on the following page)

Procedure:

1. Say: We consider "turning on the switch" an ordinary event. It is the most common device that provides us with electricity.

2. Discuss the diagram Electrical Power to discover an energy network.

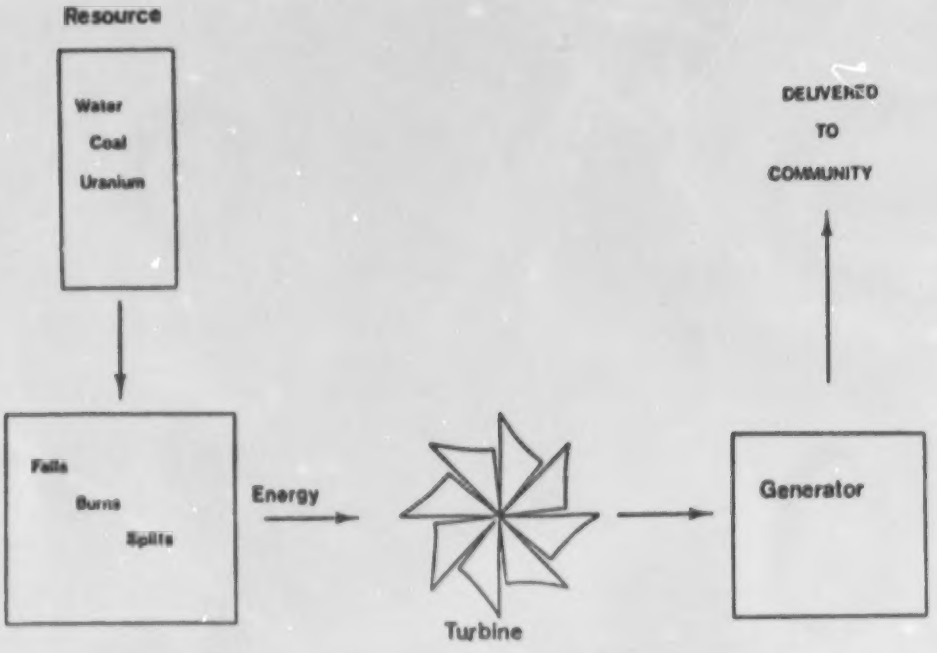
   a. Open this lesson by asking: Where does electricity come from, and how does it get to the things we use (radio, TV, etc.)? (Remind students of their answers: from the outlet, wire in the wall, etc.)

   b. Ask: How does electricity get to your house? (Accept responses such as: by utility poles; by wires.) Where is the electricity put into the wires? (at a power plant)

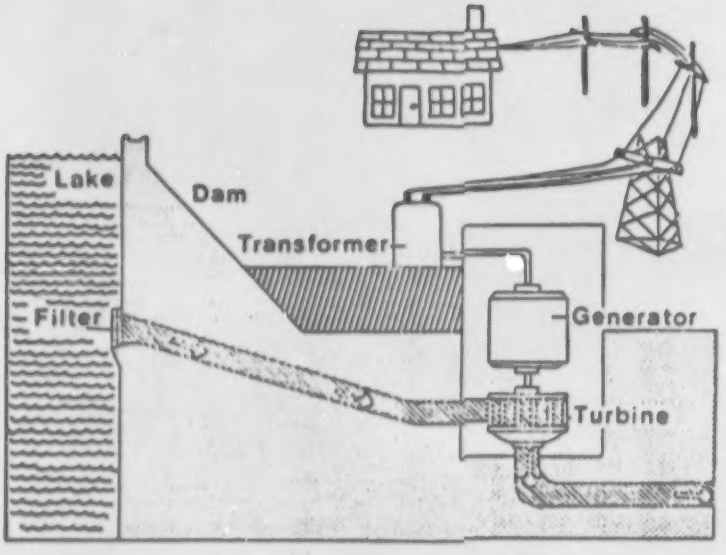
3. Discuss the diagram Power Plant. Discuss how the energy is transfered from the water power of a dam through turbines and generators in the power plant, through power lines and into a home or building.

4. Contact your city or community planning office for information about the network of electrical power in your own community. Invite someone from that office or your local electric power company to visit your class to give a short talk about electricity and electrical service in the community.

Electrical Power



Power Plant



Title: Population And Energy Supply

Purpose: To emphasize the reasons why fossil fuels are considered non-renewable and to encourage the students to compare available fossil fuel sources with present demand

Materials: 200 soda cans (or 200 objects having similar characteristics)

Procedure:

1. Have students collect 200 soda cans (or 200 of something of similar size.) Paint the cans, or dab a spot of the appropriate color on them, according to the following chart.

No. of Cans	Color	Represents Fuel
125	Black	Coal
7	Dark Brown	Oil
8	Blue	Natural Gas
57	Green	Oil Shale
3	Tan	Tar Sands

2. Mention that Oil Shale and Tar Sands are found on earth, but at the moment are not used because of the difficulty and cost of obtaining them.

3. Put all cans in a large carton and mix them up.

4. Assign each student a 25-year time period, starting with 1975-2000, and ending with whichever 25-year span may be assigned to the last pupil in your class. Have each student write in the time period he or she has been assigned on a piece of paper and pin it to clothing.

5. Have students go in turn to the carton and pick out any 22 cans, and count off the colors for a tally. On the chalk board, keep a running tally of the cans.

*The 22 cans represent the amount of energy consumed in a 25-year span.

TALLY

Cans	Sample Years				
	*Total Avail.	1975 2000	2001 2025	2006 2050	2051 2075
Coal	125				
Oil	7				
Natural Gas	8				
Oil Shale	57				
Tar Sands	3				

6. Have a student call out when any one color is used up. At this point, discuss what might happen when all of the (oil, coal, natural gas) is used up. Look in the carton. How much longer do you think the fossil fuels will last? Then what do you think will happen?

7. Remind students that oil shale and tar sands are not used at present. If these are removed from the pile, what would be the result?

8. Don't use the oil shale and tar sands cans. These green and tan cans may not be drawn from the carton until the years when they can be processed profitably. All other cans are placed in the carton and mixed. When the last can is removed, ask:

   a. How long do you think the remaining fossil fuels will last?

   b. What should we do about the oil shale and tar sands sources?

   c. Are there other sources of energy other than fossil fuels?

   d. What can we do to make fossil fuels last longer?

      a. Conserve. Use them more sparingly.
      b. Use other sources.

Title: "Who - Me?"

Purpose: To have students learn about their water heater and their family's hot water needs

Procedure:

1. Say: The first thing you need to learn about is your family's water heater. Some things you need to know are:

   a. What type of water heater is it - gas, electric, or oil?
   b. How old is it?
   c. It is insulated? Does it have an insulating blanket outside?
   d. What is its capacity? (How much water can it hold?)
   e. At what temperature is its thermostat set? What is the actual temperature of the water in the heater? (To find this out, draw water from the heater through a faucet near the bottom and check it with a thermometer.)...And, remember, the water when it comes out of your kitchen faucet, etc., will not be the same temperature as it is in the heater. The further it travels through pipes, the cooler it gets.

2. Say: Too small a water heater will not give your family enough hot water; too big a water heater will be operating inefficiently by heating unused water. So the next thing you need to discover is how much hot water your family uses. To do this, find out:

   a. How many loads of clothes are washed each week?
   b. How many loads of dishes are washed each week?
   c. During each week, how many showers or baths are taken and for how long?

3. Say: This information is then converted to daily hot water usage with the following factors:

Task	Average Hot Water Consumed per Load or Bath	
Clothes Washing	(Hot water wash)	24 Gallons
	(Warm water wash)	12 Gallons
Dish Washing		10 Gallons
Bathing	(Short shower or bath)	20 Gallons

4. Say: Total your family's weekly use of hot water and then divide by seven to get daily hot water use.

5. Ask: How does your family's daily hot water use compare with your water heater's capacity? Is the heater's capacity too small or unnecessarily large?

6. Put the following table on the chalkboard.

Family Size	Gallons of Hot Water Used Daily
2	23
3	32
4	40
5	48
6	57
7	65

a. Say: This table gives the national average daily hot water requirement for different sized families.

b. How does your family compare? - Does it use less? - Does it use more? Why?

7. Ask: Why might you run out of hot water on one day during the week but not on other days?

8. Ask: What are some ways to cut down on your family's hot water use?

Title: "Who - Me?"

Purpose: To extend study beyond the classroom and to initiate a conservation advocacy program

Procedure:

1. Say: The impact of energy conservation is only as great as the number of people involved and actively seeking and practicing conservation. The more people you can convince, enlighten, or involve in energy conservation efforts, the more energy can be saved.

2. Have students set up an Energy Conservation Task Force to plan and execute a continuing effort to collect and provide energy conservation information.

   Suggestions:

   a. Have students write short papers on energy conservation which could be used in the school or local newspaper.

   b. Develop a series of bulletin board displays dealing with the everyday practical aspects of energy conservation. Depict, for example, Bath vs. Shower, Use of a Microwave Oven, Food-Chain, Riding in a car vs. Walking, etc.

   c. Investigate the school's energy consumption patterns and make recommendations to the administration. Investigate food service, surrounding vegetation, insulation, shades or draperies, thermostat settings, busing, and athletics.

   d. Give demonstrations on conserving energy when cooking, sewing, or ironing and how to select and check appliances for energy conservation.

   e. The Energy Conservation Task Force could be organized into a regular school club.

   f. Sponsor field trips to power plants, to energy conservation activities such as an energy fair, 4-H and FHA activities dealing with energy and to the planning office or Chamber of Commerce in your area.

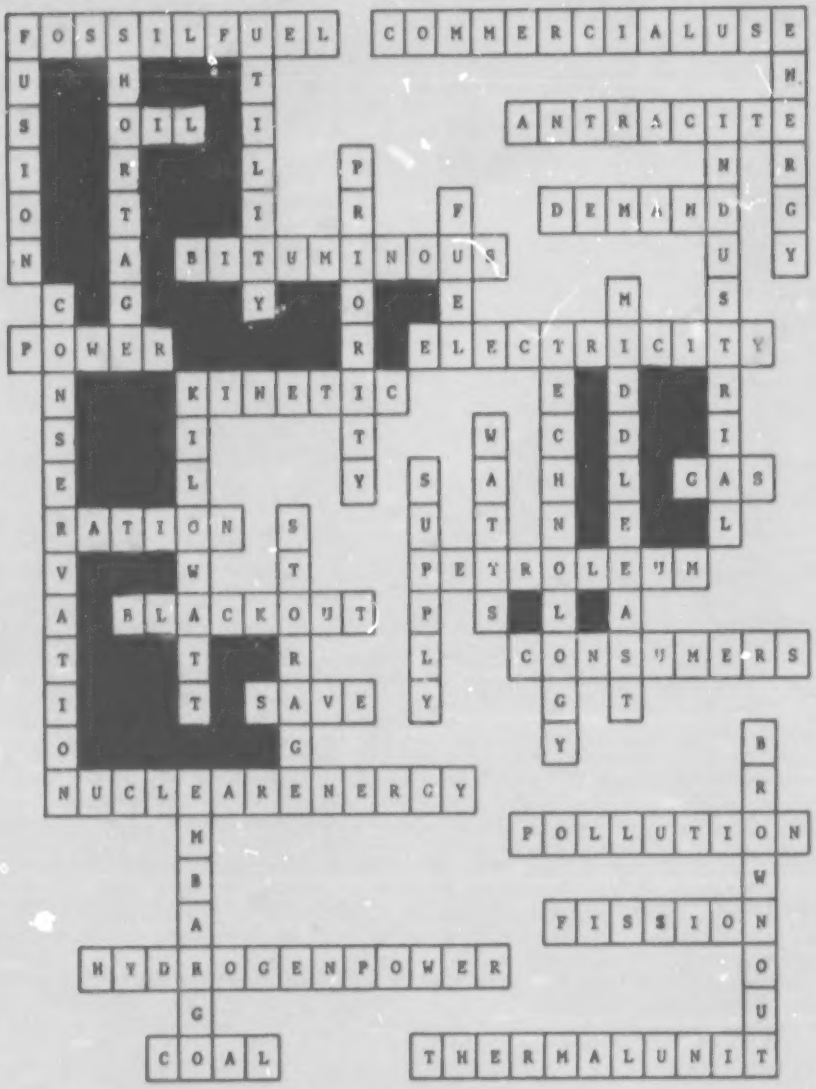
   g. Design, print and sell "Energy Conservation T-Shirts."

   h. Sponsor a school energy fair.

Title: "Who - Me?"

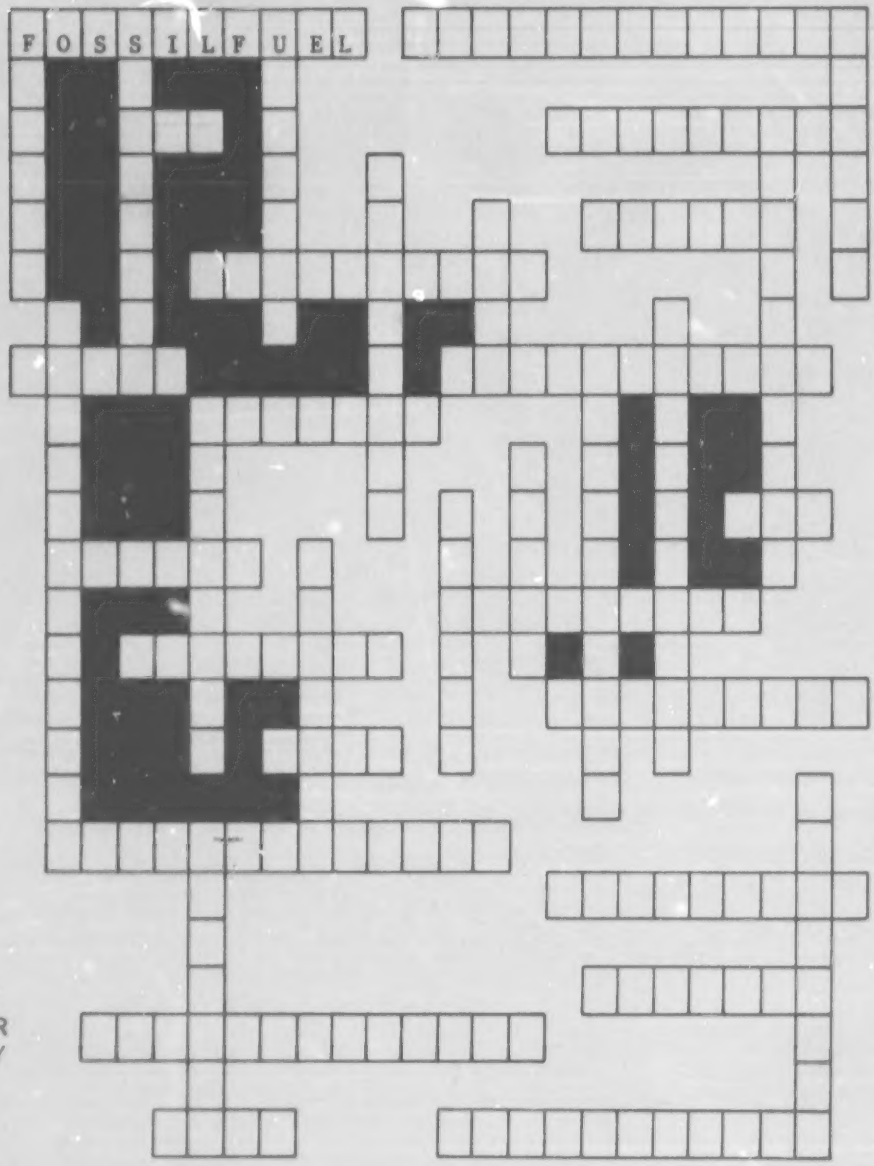
The puzzle on the following page has been developed to acquaint the student with terminology of energy. Completion of the puzzle can be accomplished in 25 to 35 minutes. When all students have completed the puzzle, direct questions concerning the usage of these words to the students. Some examples are: What are the sources of energy found in this list? What terms are associated with the future solutions to the energy crisis?

KEY



Criss-Cross Instructions: Fit the words supplied with each diagram into their proper places in the puzzle squares. The words are in alphabetical order. Where two word responses fit into the puzzle, do not leave a space between the two words.

GAS
OIL
COAL
FUEL
SAVE
POWER
WATTS
DEMAND
ENERGY
FUSION
RATION
SUPPLY
EMBARGO
FISSION
KINETIC
STORAGE
UTILITY
BLACKOUT
BROWNOUT
KILOWATT
PRIORITY
SHORTAGE
ANTRACITE
CONSUMERS
PETROLEUM
POLLUTION
BITUMINOUS
FOSSIL FUEL
INDUSTRIAL
MIDDLE EAST
TECHNOLOGY
ELECTRICITY
THERMAL UNIT
CONSERVATION
COMMERCIAL USE
HYDROGEN POWER
NUCLEAR ENERGY



VOCABULARY OF ENERGY

Find the energy related items in the puzzle. The terms may be found spelled vertically, or horizontally, or diagonally, or backwards. Words used in the puzzle are:

ANTHRACITE
BITUMINOUS
BLACKOUT
BREEDER REACTOR
BRITISH THERMAL UNIT
COMMERCIAL USE
CONSERVATION
CONSUMER
CRISIS
ELECTRICITY
EMBARGO
ENERGY
ENVIRONMENT
ERG
FISSION
FOSSIL FUEL
FUEL
FUSION
GAS
GEOTHERMAL
HYDRO
INDUSTRIAL USE
ION
KILOWATT
KINETIC
LEAD
MIDDLE EAST
NUCLEAR ENERGY
OIL
PETROLEUM
POLLUTION
POTENTIAL
POWER
PRIORITY
RATIONING
REFINERY
SHORTAGE
SITE
SUN
TECHNOLOGY
UTILITY
VOLTAGE
WATTS
WIND
WINDMILL

Z	O	B	R	A	N	C	T	Y	G	O	L	O	N	H	C	E	T	Y	L	O	E	T	Y	Q
E	E	N	E	R	G	O	F	O	Y	I	A	N	P	T	I	U	Q	S	B	W	A	T	T	S
B	I	T	E	N	E	R	G	Y	T	L	B	R	O	W	O	K	I	L	I	A	T	S	I	H
R	L	K	B	I	O	R	Y	C	I	T	E	N	I	K	N	L	O	N	T	T	W	A	R	O
A	H	A	R	O	T	I	T	U	L	R	S	B	C	R	O	U	D	T	U	H	N	I	O	R
N	U	L	E	C	H	G	I	A	I	M	R	A	E	H	T	M	H	S	M	I	U	T	I	T
I	G	T	E	B	E	A	C	K	T	U	L	M	I	N	I	O	U	P	I	N	C	H	R	A
T	N	S	D	R	R	E	I	S	U	B	O	D	U	L	A	L	F	O	N	S	L	S	P	G
T	I	A	E	O	M	E	R	G	L	E	R	U	L	S	U	F	L	P	O	W	E	R	I	E
H	N	E	R	M	A	O	T	L	K	I	L	O	W	A	T	T	H	O	U	R	A	P	O	S
E	O	E	R	E	L	E	C	R	I	S	I	S	W	G	T	O	R	B	S	R	R	E	W	U
R	I	L	E	D	C	E	E	R	R	N	E	A	C	N	T	I	R	O	N	S	E	E	N	L
D	T	D	A	N	O	L	L	E	U	F	L	I	S	S	O	F	C	E	U	R	N	T	E	A
E	A	D	C	O	N	S	E	R	V	A	T	I	O	N	R	U	E	N	E	V	E	I	S	I
B	R	I	T	I	S	H	T	H	E	R	M	A	L	U	N	I	T	W	I	E	R	C	U	R
R	E	M	O	T	U	G	Y	H	Y	D	R	O	T	E	C	H	O	R	N	O	G	A	L	T
N	S	P	R	U	M	O	Y	P	R	T	U	L	L	O	P	P	O	G	O	L	Y	R	A	S
C	I	O	S	L	E	R	I	S	E	I	S	E	L	E	N	N	C	T	R	V	I	H	I	U
L	O	T	O	L	R	T	E	P	F	T	Y	T	I	E	M	B	A	R	G	O	C	T	C	D
F	U	E	L	O	M	F	U	I	I	L	R	C	G	E	O	N	S	U	M	L	E	N	R	N
E	A	N	U	P	T	A	S	R	N	L	L	O	N	I	M	D	N	I	W	T	R	A	E	I
I	L	T	O	N	I	S	N	G	E	M	R	T	L	B	A	R	G	O	M	A	T	D	M	O
I	S	I	U	F	I	Y	R	E	R	D	N	I	F	E	R	T	S	A	E	G	E	L	M	L
O	N	A	N	O	K	I	N	E	Y	T	I	C	L	F	U	S	I	O	N	E	T	I	O	I
R	T	L	N	D	N	I	Y	H	T	I	R	O	I	R	P	M	R	H	T	N	A	Y	C	T

Title: Solar Energy For Power

Purpose: To find out how much solar heat comes from the sun to you

Materials: Two foam cups
Two thermometers
Food colors
Aluminum foil
Graduated cylinder
Metric ruler
Watch
Insulation material (packing foam, crumpled newspaper, etc.)
Cardboard box (should be same height as cups: trim if necessary.)

BACKGROUND INFORMATION:

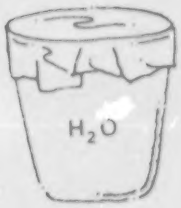
Note: Scientists have measured the amount of solar energy beyond our atmosphere at about 2.0 calories per square centimeter per minute. About 1.5 calories per square centimeter per minute reaches earth after passing through our atmosphere. This is called the Solar Constant.

Procedure:

1. Set up this experiment

   a. Fill the foam cups with a measured amount of cold water.

   b. Add food colors to one cup.



Cover This Cup With Aluminum Foil to Reflect Sunlight.

Add Food Colors to H_2O In This Water To Make This Water As Black As Possible - This Absorbs Sunlight.

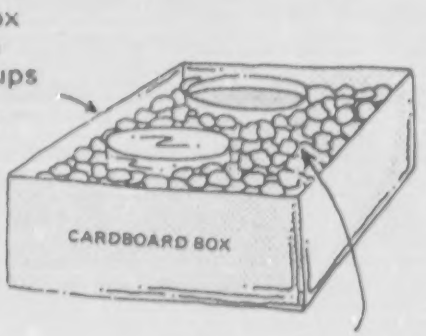
c. Trim a cardboard box to the same height as the cups.

d. Put the cups in the box and add the insulation material.

e. Put the box in the sun for 10 minutes. (noon to 1 p.m. is usually hottest.)

f. Stir the water in the cups with the thermometers and record the temperatures.

Cover This Cup
With Aluminum Foil



Pack Insulation
Into All Spaces
Around The Cups

2. Do this calculation:

$$\text{Area} = \frac{d}{4} = \underline{\qquad\qquad} \text{ square centimeters}$$

$$\text{Calories} = \frac{\text{ml of } H_2O \text{ in 1 cup} \times \text{Difference in temperatures of both cups after being in the sun for 10 minutes.}}{\text{Area (square centimeters) of water} \times 10}$$

The "calories" calculation is the amount of solar heat received on 1 square centimeter in 1 minute at your location.

Multiply x 10,000 to get the results for 1 square meter!

Title: Solar Energy For Power

Purpose: To find out how hot a box gets with a convection-type solar collector in 5, 10, and 15 minutes

Materials: 2 white or white-painted boxes, at least 35 cm high x 45 cm long x 30 cm wide (dimensions may vary, but boxes should be about the same size)

Duct tape (local hardware store of building supply)

Tape or stapler

Knife or scissors

About 40 cm square piece 3- or 4-mil clear plastic (local hardware or garden stores)

4 thermometers

Flat black spray paint

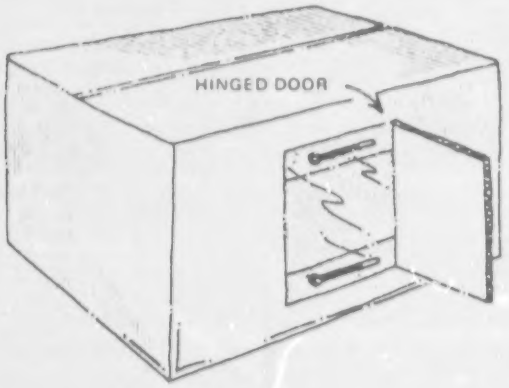
Galvanized sheet metal (dimensions based on size of cardboard box - see instructions) - (local hardware store or building supply)

Cardboard (See instructions for amount required)

Insulation material (styrofoam, cardboard, newspaper, etc.)

Procedure:

1. Construct A Control Box



CUT A HINGED DOOR.

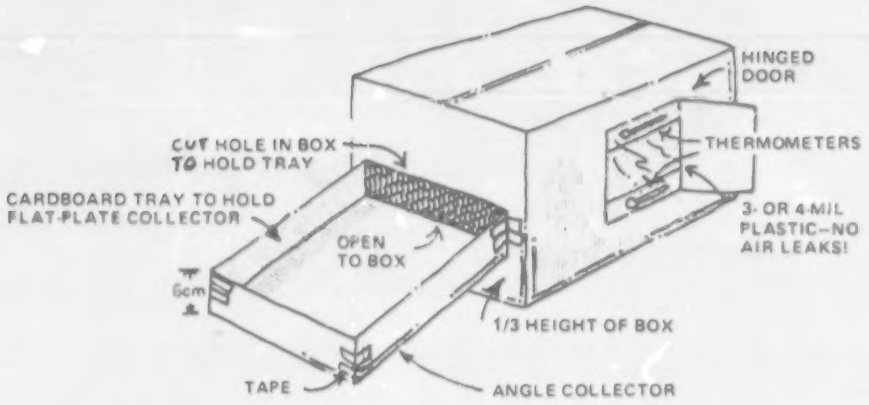
TAPE 3- or 4-MIL PLASTIC TIGHTLY TO INSIDE OF BOX—NO AIR LEAKS!

TAPE THERMOMETERS INSIDE WINDOW AT TOP AND BOTTOM—YOU MUST BE ABLE TO READ THEM THROUGH THE WINDOW.

SPRAY THE OUTSIDE OF THE BOX WHITE IF A WHITE BOX IS NOT AVAILABLE.

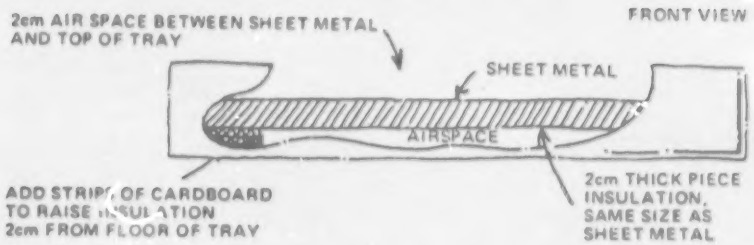
2. Construct a Solar Collector Box

Make another box like the one above, but add a cardboard tray:

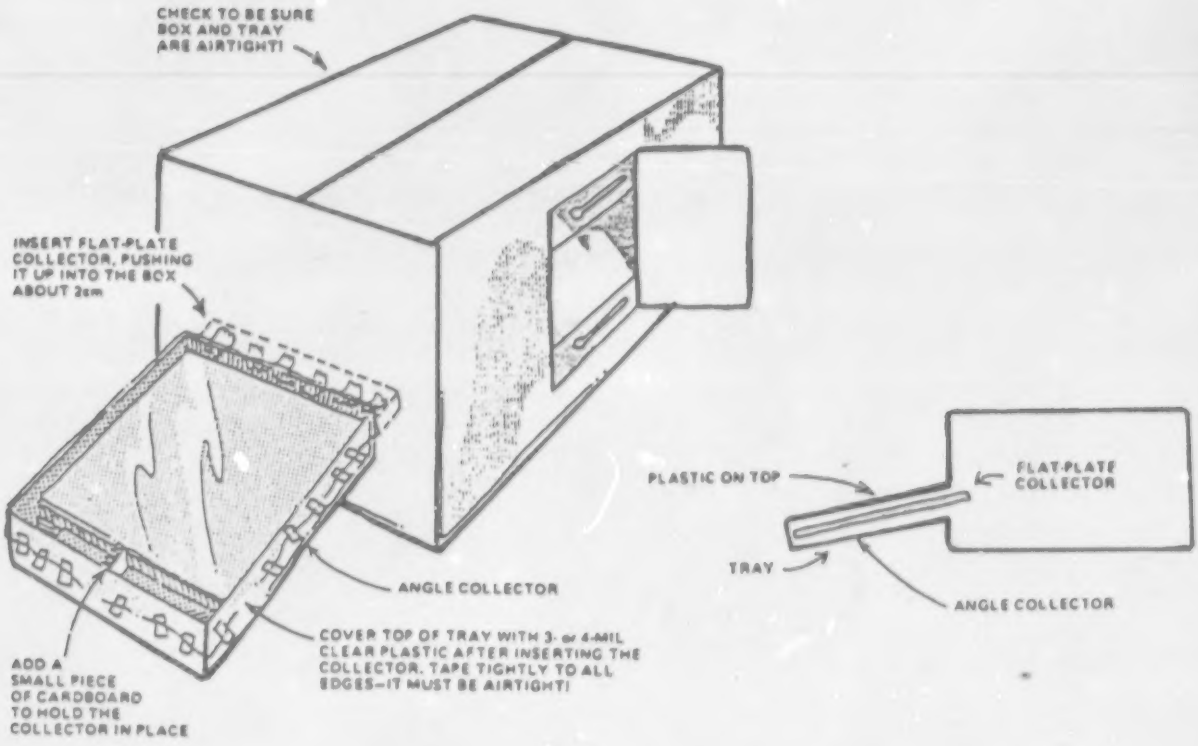


3. Construct a Flat-plate Collector

Cut galvanized sheet metal to fit snugly into cardboard tray, and spray paint the sheet metal flat black.


2cm AIR SPACE BETWEEN SHEET METAL AND TOP OF TRAY
FRONT VIEW
SHEET METAL
AIRSPACE
ADD STRIPS OF CARDBOARD TO RAISE INSULATION 2cm FROM FLOOR OF TRAY
2cm THICK PIECE INSULATION, SAME SIZE AS SHEET METAL

4. Set Up Your Experimental Box


CHECK TO BE SURE BOX AND TRAY ARE AIRTIGHT!
INSERT FLAT-PLATE COLLECTOR, PUSHING IT UP INTO THE BOX ABOUT 2cm
ANGLE COLLECTOR
COVER TOP OF TRAY WITH 3- or 4-MIL CLEAR PLASTIC AFTER INSERTING THE COLLECTOR. TAPE TIGHTLY TO ALL EDGES—IT MUST BE AIRTIGHT!
ADD A SMALL PIECE OF CARDBOARD TO HOLD THE COLLECTOR IN PLACE
PLASTIC ON TOP
FLAT-PLATE COLLECTOR
TRAY
ANGLE COLLECTOR

5. Conduct Your Experiment Like This:

   a. Read and record the temperatures of both the thermometers in the control and experimental boxes.

   b. Place the boxes in the sun.

   c. Record the temperature of each thermometer after 5, 10, and 15 minutes.

   d. Compare the results.

   e. Can you describe how the air moves inside the control box? In the experimental box?

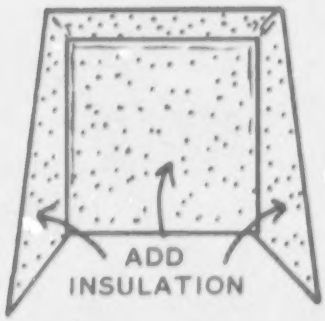
Title: Solar Energy For Power

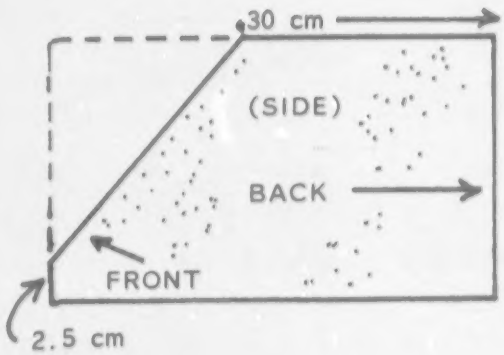
Materials:

- Oven thermometer
- Cardboard box, approximately 70 cm long x 45 cm wide x 35 cm high
- 1 sheet rigid foam insulation, 5 cm thick (buy the type with an aluminum foil backing) (local building supply store)
- 1 pane thermal glass (dimensions depend on size of box - see instructions) (local hardware store or building supply)
- Duct tape (local hardware store or building supply)
- Flat black spray paint
- Glue
- Plywood; gypsum board (dimensions depend on size of box; see instructions for base) (local hardware store or building supply)
- Weather-stripping (local hardware store or building supply)
- Cardboard pieces
- Aluminum foil
- 4 coat hangers

Procedure: To prepare the Cardboard Box Frame:

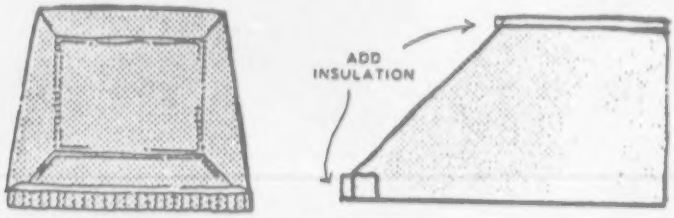
1. Remove the bottom and one end from the box. Then cut the top and sides as illustrated below.





2. Use the sides and back of the box as a pattern to cut insulation that fits the sides and back of the box precisely. Glue them in with the aluminum foil side against the box.

3. Now add insulation to the top and front of the box: it should extend about 1.25 cm beyond the open edge. Again, glue it into place.



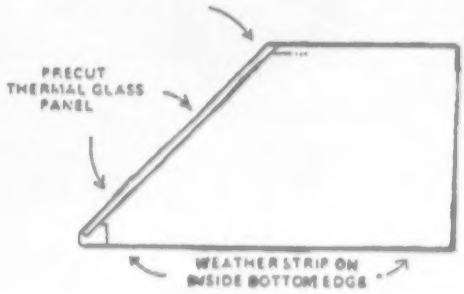
4. Paint the interior of the box with flat black spray paint to absorb extra heat.

5. Trim the insulation at an angle so the glass will sit evenly on it.

6. Add a precut pane of thermal glass to the front of the oven and seal securely with duct tape.

7. Tape the glass tightly on all edges with duct tape.

8. Add weather stripping to the cardboard box frame. Use duct tape of glue to hold it in place.



Now Build the Oven Base

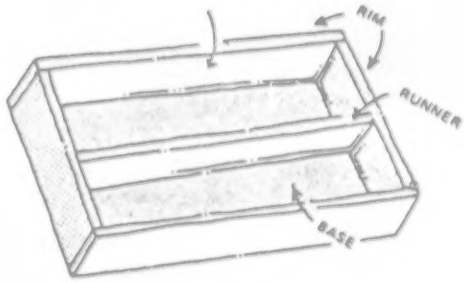
1. Cut a plywood base 5 cm longer and 5 cm wider than the base of the oven.

2. Rim the base with more plywood 5 cm high, and add a runner down the center.

3. Fill the spaces with insulation, then cover the entire top of the box with a piece of gypsum board cut the same size as the plywood base.

4. Paint the gypsum flat black.

5. Center the oven on top of the base.

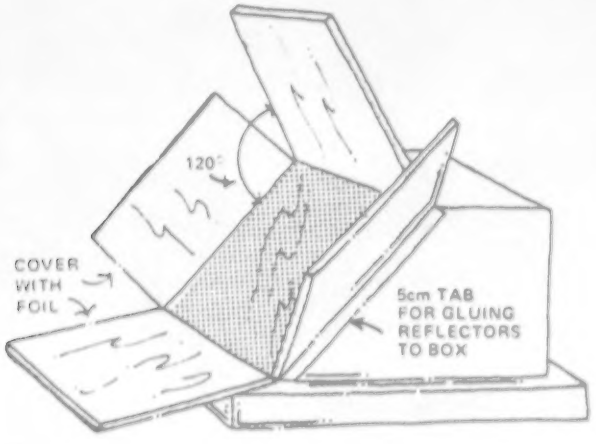


Now Add Reflectors

1. To make reflectors, cut 4 pieces of cardboard the size of the thermal glass plus 5 cm larger on one side. This extra 5 cm will be creased to serve as a tab to attach the reflectors to the oven.

2. Cover the reflectors with aluminum foil, shiny side out, attaching the foil with glue.

3. Use the straightened coathangers to prop the reflectors at a 120° angle to the face of the oven.



INVESTIGATIONS

1. How long does it take your oven to cook hamburgers? other foods?

2. Would a second pane of glass and more insulation help you achieve a higher temperature?

3. At what times is your oven most efficient?

Title: Stored Energy And Work

Purpose: To understand how the exterior color of a home can affect the interior temperature

Objectives:

1. The students will be able to read a thermometer and record the temperature.
2. The students will be able to identify the colors most likely to generate the coldest and the warmest interior temperatures and explain why this happens.
3. The students will list at least three non-energy consuming ways in which dark colored homes may be kept cool in summer.

Materials: Large one-gallon cans, paint (white, light brown, dark brown, green, gray), water, small pieces of plywood, thermometer

Procedure:

1. Select a sunny, warm day.
2. Divide students into small groups, each group with 5 one-gallon cans.
3. Have students paint each can a different color. We've suggested white, light brown, dark brown, green, and gray as being typical house colors. However, as a first step, you might want to have students survey their town to determine common house colors and then use those colors.
4. Take the cans outside into the sun and fill each with water. Cover each can with a small piece of plywood or similar material.
5. Let each can stand in the sun for a given period of time, about 20 to 30 minutes. (It might take longer to show a differential temperature.)
6. Then have each group of students check the temperature of the water in each can and record it.
7. Ask students which color generated the warmest temperature, and which the coolest temperature.
8. Ask students why these results occurred.
9. Relate the results to home color and heating in the winter.
10. Ask students how they will control this effect in the summer.

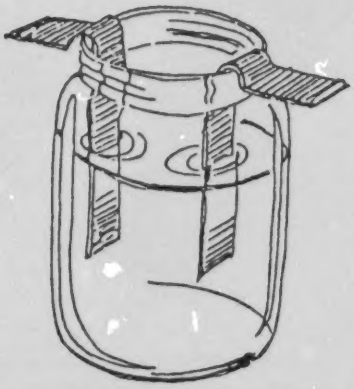
Title: Stored Energy And Work

Purpose: To teach students how to construct a simple electrical cell

Materials: Plates of copper and zinc, dilute sulphuric acid, glass jar, crystals of potassium dichromate (optional)

Procedure:

1. Look at and follow the diagram below. Instruct students to dip plates of copper and zinc into a jar of dilute sulphuric acid.
2. Tell students that the plates must be shaken occasionally to remove the gases.
3. A few crystals of potassium dichromate will remove the gases chemically.



Title: Stored Energy And Work

Objective: To teach students to construct an electromagnet from elements found in the home workshop

Materials: iron bolts about 5 cm long, washers, nuts, insulated bell wire, tape, dry cells, tacks and nails, other iron or steel objects, compass

Procedure:

1. Distribute the materials to the students.

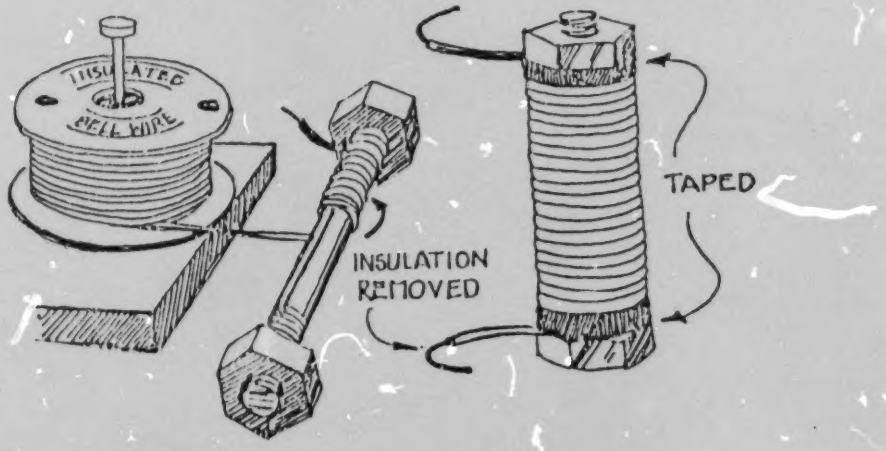
2. Give them the following directions (on the board, orally, or on a handout) for making the electromagnet:

   a. Secure the bolt with a nut and two washers. Place a washer at each end and screw the nut just onto the bolt.

   b. Wind layers of insulated bell wire on the bolt between the washers. Be sure to leave 30 cm of wire sticking out when beginning to wind the coil.

   c. After the bolt is filled with several layers or turns of wire, leave about 30 cm of wire sticking out and cut the wire.

   d. Twist the two ends of the wire close to the ends. Then wind short lengths of tape at the ends of the bolt to keep the wire from unwinding.



e. Remove the insulation from the two ends of the wire.

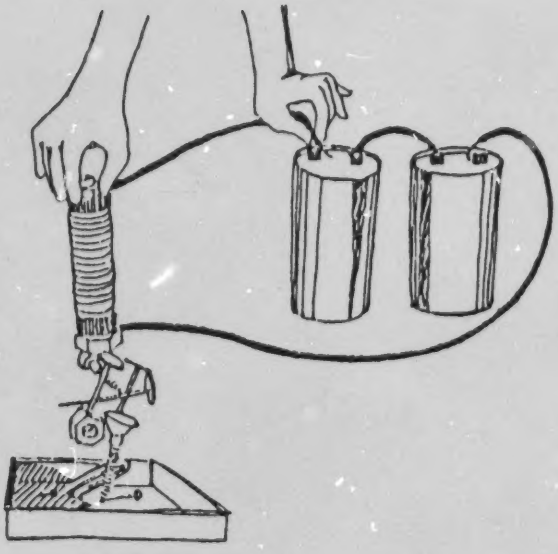
f. Connect two dry cells in a series and attach the electromagnet to these.

g. Pick up some tacks and nails.

h. Disconnect one wire from the battery while the tacks are still attached.

i. Pick up other objects made of iron or steel.

j. Test the poles of each end of the magnet with a compass while the current is turned on.



Title: Stored Energy And Work

Purpose: To teach students to construct a simple electric motor

Materials: 20 cm x 25.5 cm board, drill, penknife, spikes (15.5 cm, 15 cm, 13 cm), insulated bell wire, small nails, 4 cm cork, 10.5 cm or 13 cm test tube, sheet copper, adhesive tape, dry cells

Procedure:

1. Say: This simple model will use current from the battery to excite the field magnets as well as the armature coil.

2. To construct the field magnets and brushes:

   a. Prepare a board 20 cm by 25.5 cm for the base.

   b. Drill a small hole through the center.

   c. Drive a 15.5 cm spike up through it.

   d. Wind 100 turns of insulated bell wire neatly onto two other 15 cm spikes. Leave about 30 cm for free ends.

   e. Drive these spikes into the base 15.5 cm apart.

   f. Drive two small nails on the diagonal and 5 cm from the spike at the center.

   g. Strip the free ends of each coil and twist them several times around the nails and bend them so that they will rest in contact with the central spike. These ends will serve as brushes.

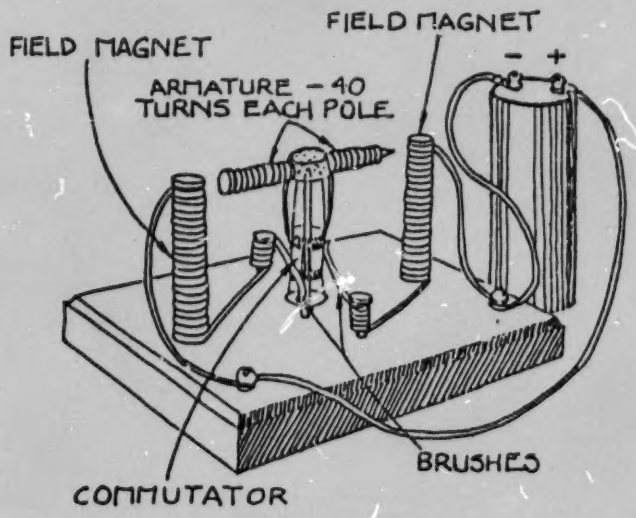
      Care must be taken to have the field coils wound in the proper direction. The diagram on the following page is a complete plan for the direction of the windings. It won't work any other way. The other ends of the coils may be fastened to screws in the corners of the base.

      The field magnets, two of the essential four parts of a motor, are now complete.

3. The armature coil and commutator remain to be constructed:

   a. Drill a hole crosswise through the top of a 4 cm cork and force a 13 cm spike through it.

   b. Wind about 40 turns of insulated bell wire onto each end. Be sure to follow the diagram on the following page for the direction of the windings.



   c. Scrape the free ends.

   d. Gouge out the center of the cork neatly. Round with a penknife and insert into the closed end of 10.5 cm or 13 cm test tube. This completes the armature coil.

4. You are now ready to make the commutator.

   a. Cut out two rectangular pieces of sheet copper about 4 cm long and wide enough to reach the test tube with about 6 cm space between. Curve these to fit the tube.

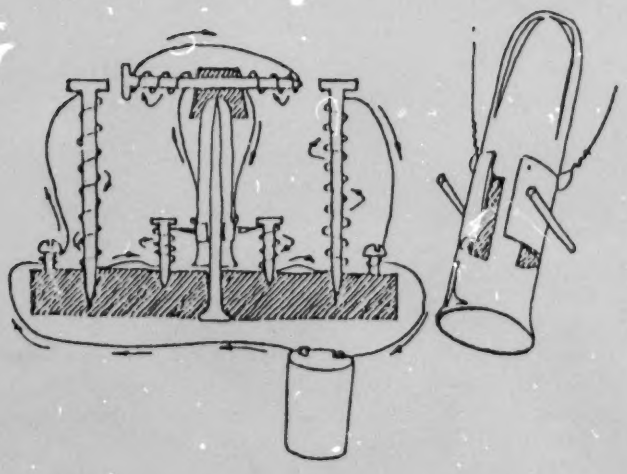
   b. Punch small holes, twist one of the scraped free ends of the armature winding into each.

   c. Bind these commutator plates securely into position at top and bottom with adhesive tape.

5. The rotor, consisting of armature and commutator, is now complete. Set it into position on the vertical bearing and bring the brushes into contact with the commutator.

6. If the windings and connections are as shown, connect to one or two cells; with a slight push of the armature, it should start off at a lively clip.

7. It it does not do so, examine the brushes to see whether they make a light, but certain, contact. It also may help to change the angle of the brushes. To test this point, untwist the brushes from the nails and hold them lightly against the commutator plates with the fingers. While holding them, always parallel, swing them around at different angles while a helper turns the armature with his hand. Note the point at which the armature picks up most speed and set the brushes at that point. With a little patience, your class will be successful and will be well rewarded for their efforts.



Title: We Change Environments

Purpose: To address the topic of the sources of electrical energy

Materials: Copies of SOURCES OF FUEL USED TO PRODUCE ELECTIRICITY (on next page)

Procedure:

1. Give a copy of the map to each student.
2. Have students study the map, SOURCES OF FUEL USED TO PRODUCE ELECTRICITY.
3. Ask these questions and have students answer Yes or No.
   a. Is coal found in the East? (Yes)
   b. Are there oil fields in the West? (Yes)
   c. Are uranium resources found in the Southwest? (Yes)
   d. Is oil found near the Great Lakes? (Yes)
   e. Do all of the states have gas and oil fields? (No)
   f. Could a coal miner probably find work in West Virginia? (Yes)
   g. Are there large coal deposits west of the Mississippi River? (Yes)
   h. Does the Southwest have many oil and gas fields? (Yes)
   i. Is either coal or oil found in Montana? (Yes)
4. Find your state on the map. Are there any fuel deposits in your state? Name them. (Answers will vary.)
5. Draw a network. Start with the source of the energy and get electricity to your home; to a neighbor's home; to a friend's home in another town. Network should show these components: energy source (coal, oil, gas, uranium, hydroelectric, in some cases geothermal); boiler (except for water power); turbine; generator transformer; power lines.

SOURCES OF FUEL USED TO PRODUCE ELECTRICITY

Title: Electricity is....

Purpose: To construct and conduct experiments using propellers

Procedure:

1. Follow directions for making propellers and answer questions.

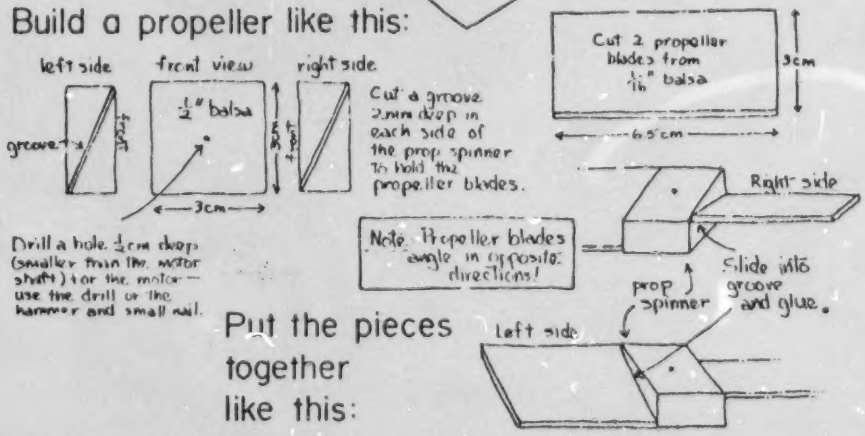
WHAT IS THE BEST ANGLE AT WHICH TO SET THE BLADES OF A PROPELLER TO MAKE ELECTRICITY?

MATERIALS:

- Balsa wood, 1/16" thick piece ← Use for making all propellers in Activities 8 and 9
- Balsa wood, 1/2" thick piece
- Small 1 1/2 volt DC motor ← (available from the American Museum of Science & Energy - about 50¢)
- Voltmeter, 0-5 volts ← (try a local electronics hobby shop)
- 100 ohm, 1/2-watt resistor
- Powerful 2-or 3-speed room fan ← (different fans give different results - experiment with more than one)
- Fine hacksaw blade, glue
- Single-edged razor blade (Warning in this direction!)
- Small nail and hammer or drill
- Plastic insulated hookup wire, about 30cm
- Plastic model airplane propeller

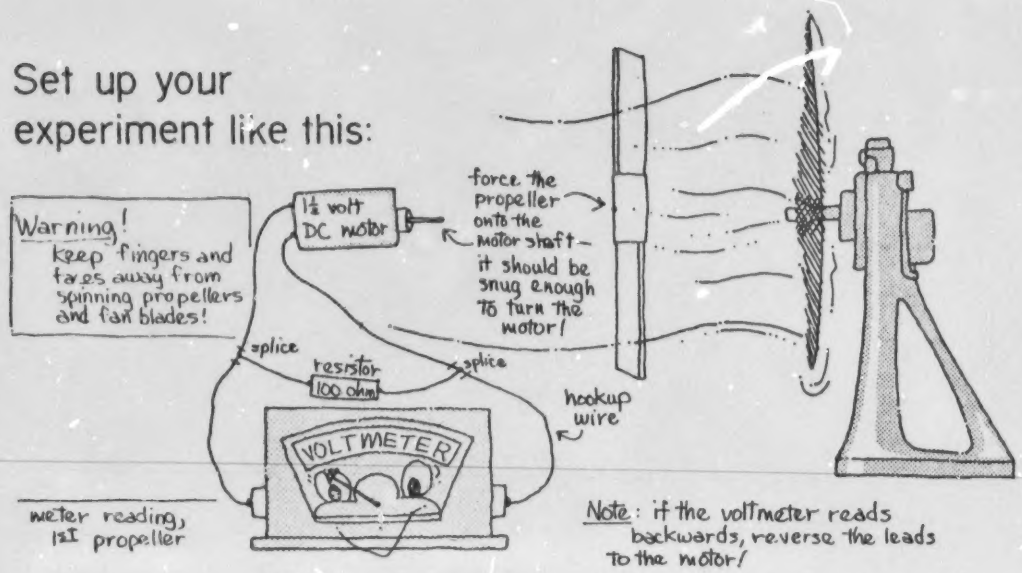
Note: The balsa propellers you make below do not have an airfoil shape -- the model airplane propeller does.

Build a propeller like this:

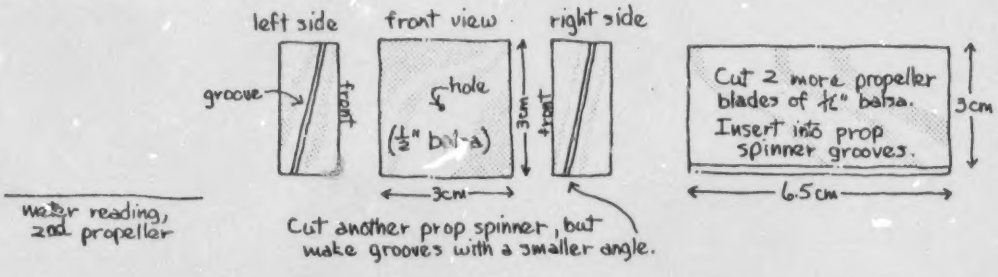

left side
front view
right side
groove
3cm
1/2" balsa
3cm
3cm
Cut a groove 2mm deep in each side of the prop spinner to hold the propeller blades.
Drill a hole 1/2cm deep (smaller than the motor shaft) for the motor — use the drill or the hammer and small nail.
Cut 2 propeller blades from 1/16" balsa
3cm
6.5cm
Right side
Note: Propeller blades angle in opposite directions!
prop spinner
Slide into groove and glue.
Left side

Put the pieces together like this:

Set up your experiment like this:


Warning!
keep fingers and faces away from spinning propellers and fan blades!
1½ volt DC motor
force the propeller onto the motor shaft – it should be snug enough to turn the motor!
splice
resistor 100 ohm
splice
hookup wire
VOLTMETER
meter reading, 1st propeller
Note: if the voltmeter reads backwards, reverse the leads to the motor!

Now, build a second propeller; test it like the first.

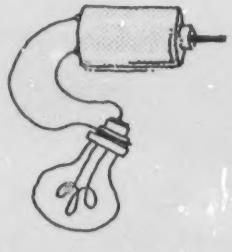


Which angle produced more electricity?

OTHER IDEAS TO EXPLORE:

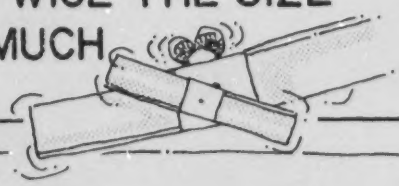
How much electricity will be produced if the wind speed is cut in half?

Can make you enough electricity to light a single flashlight lamp?



Science Activities in Energy

WILL A PROPELLER TWICE THE SIZE PRODUCE TWICE AS MUCH ELECTRICITY?



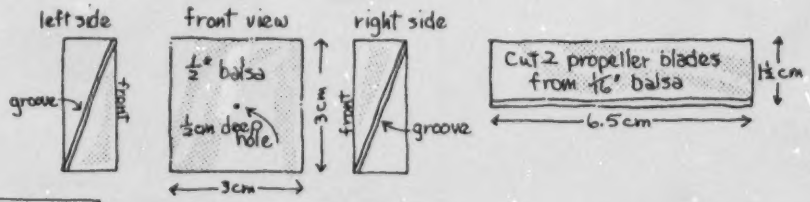
MATERIALS:

- Balsa wood from Activity 8
- Powerful 2- or 3- speed room fan (different fans give different results – experiment with more than one)
- Fine hacksaw blade; single-edged razor blade (Teacher's Discretion)
- Small nail and hammer or drill; glue
- *Small 1 1/2 volt DC motor (available from the American Museum of Science & Energy – about 50¢)
- * Voltmeter, 0-5 volts (Try a local electronics hobby shop)
- *100 ohm, 1/2 watt resistor
- *Plastic insulated hookup wire, about 30cm
- *Basic propeller from Activity 8
- Plastic model airplane propeller

*Note: if you have completed Activity 8, these materials are already assembled!

Note: The balsa propellers you make below do not have an airfoil shape — the model airplane propeller does.

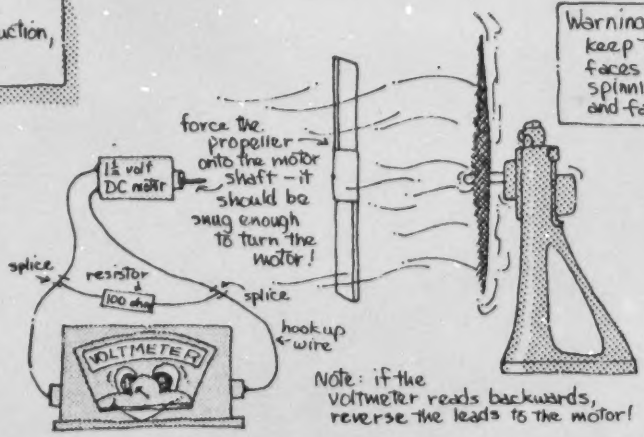
Build this propeller version:



Note: follow basic propeller construction, Activity 8.

Warning! keep fingers and faces away from spinning propellers and fan blades!

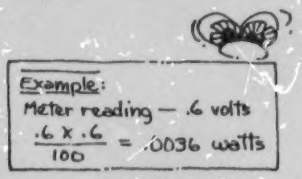
Set up your experiment like this:



Note: if the voltmeter reads backwards, reverse the leads to the motor!

OTHER IDEAS TO EXPLORE:

Calculate and compare the electric power produced:

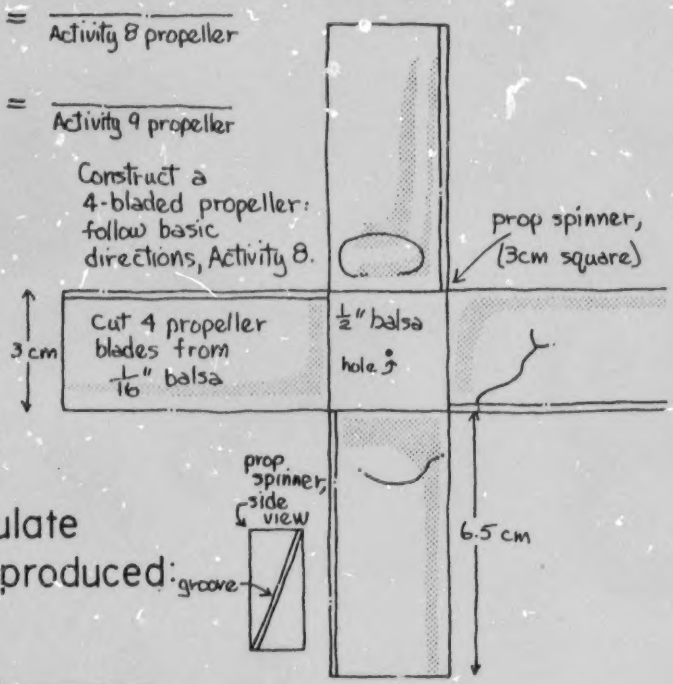


$$\text{POWER} = \frac{\text{VOLTAGE} \times \text{VOLTAGE}}{100}$$

= Activity 8 propeller

= Activity 9 propeller

Will a 4-bladed propeller produce more electricity than a 2-bladed propeller?

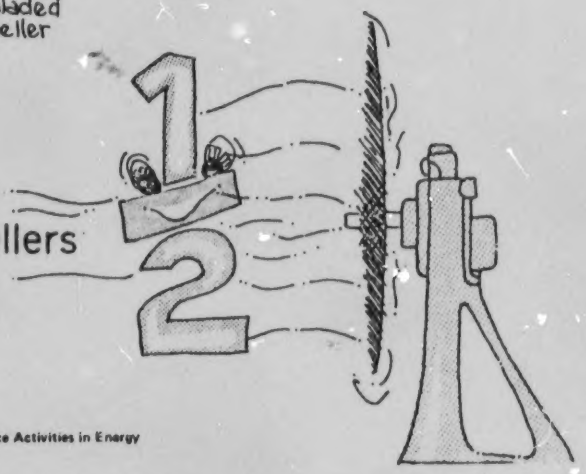


Test this propeller as above, and calculate the electric power produced:

$$\text{POWER} = \frac{\text{VOLTAGE} \times \text{VOLTAGE}}{100} = \text{4-bladed propeller}$$

Compare the results of all propellers.

How would your propellers work if you cut the wind speed in half?



Title: Wind Energy

Purpose: To learn how to estimate wind speed by observation

Procedure:

1. To find out at what time of day there is enough wind to make electricity, measure (estimate) the wind with the Beaufort Wind Scale:

*mph = miles per hour

Beaufort Number	Description	Observation
0	Calm (0-1 mph)	Smoke rises vertically
1	light air (2-3 mph)	Smoke drifts slowly
2	slight breeze (4-7 mph)	Leaves rustle; windvane moves
3	gentle breeze (8-12 mph)	Twigs move, flags extended
4	moderate breeze (13-18 mph)	Branches move; dust and paper rise
5	fresh breeze (19-24 mph)	Small trees sway
6	strong breeze (25-31 mph)	Large branches sway; wires whistle
7	moderate gale (32-38 mph)	Trees in motion; walking difficult
8	fresh gale (39-46 mph	Twigs break off trees
9	strong gale (47-54 mph)	Branches break; roofs damaged
10	whole gale (55-63 mph)	Trees snap; damage evident
11	storm (64-72 mph)	Widespread damage
12	hurricane (73-82 mph)	Extreme damage

2. Keep a record of the wind speeds at different times of day.

3. At what time of day do the fastest winds usually occur?

4. Are the winds in your area steady or gusty?

5. How many hours during the day could a wind generator make electricity based on your observations?

6. Can you predict the winds from the clouds or other signs? How accurate are you?

7. What kinds of clouds are ovehead?

8. What wind speeds are associated with different types of clouds?

9. How accurate is the weather bureau in predicting the winds in your area?

Title: Earth Heat

Purpose: To discover the relationship between the earth's heat and man's need for new energy sources

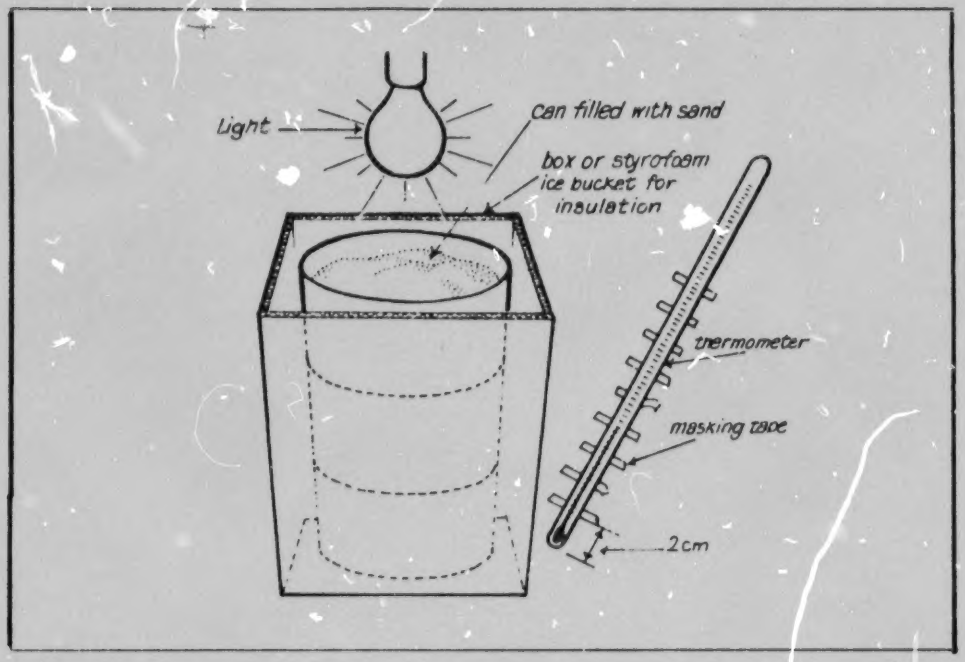
Materials: Sand (enough to fill the can), 300-watt bulb or heat lamp, thermometer (0-100°C and long enough to reach the bottom of can), cardboard box large enough to hold the can

Procedure: Activity 1

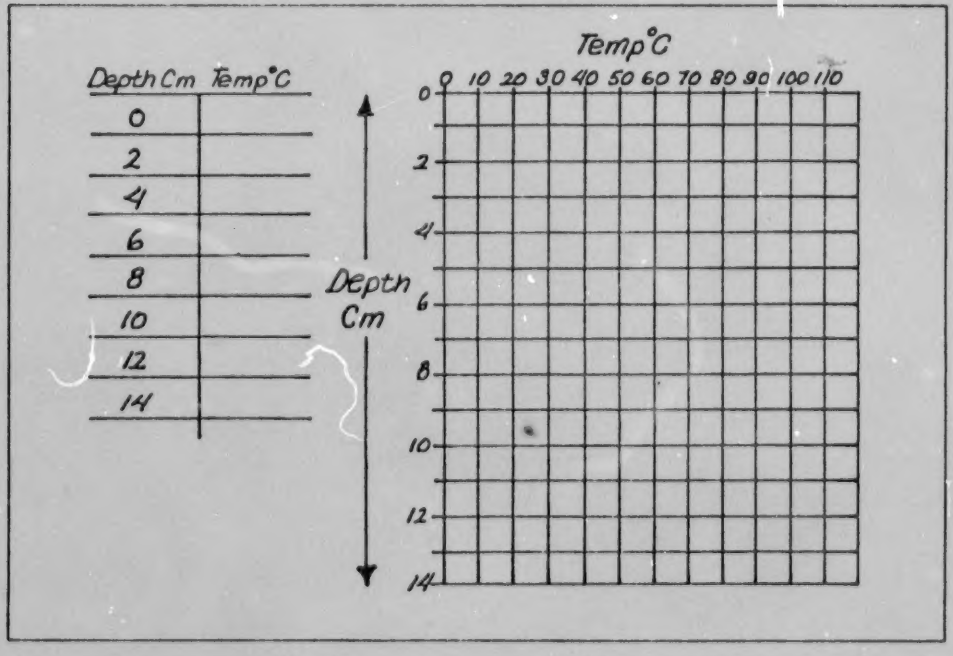
1. Set up the can of sand, box, and light as shown in the diagram on the next page.
2. Say: The sand in the can represents a section of the Earth's continental crust. The light bulb represents the sun.
3. Adjust the light source so that it is about 30 cm above the sand.
4. Turn on the light and heat the sand for 15 minutes.
5. While the sand is heating, start at the bulb end of the thermometer, and use pieces of masking tape to place marks on the thermometer every 2 cm. Do not put the tape over the scale of the thermometer.
6. After 15 minutes remove the light source and take the temperature of the sand at the surface. Then push the thermometer down 2cm into the sand, let the temperature adjust, and record the temperature on the table below. Continue to take the temperature at 2cm increments to the bottom of the can.
7. Plot the depth and temperature on a graph. (example on next page)

Activity 2 - Discussion and Questions

1. Does the temperature go up or down as you go deeper in the sand? Is this what you expected?
2. Is the light bulb the source of all the heat in the sand? If not, where did this heat come from?
3. Did the temperature change the same number of degrees for each 2 cm depth in the can?
4. What was the average temperature change for each cm increase in depth?



Depth Cm	Temp°C
0	
2	
4	
6	
8	
10	
12	
14	



Activity 3

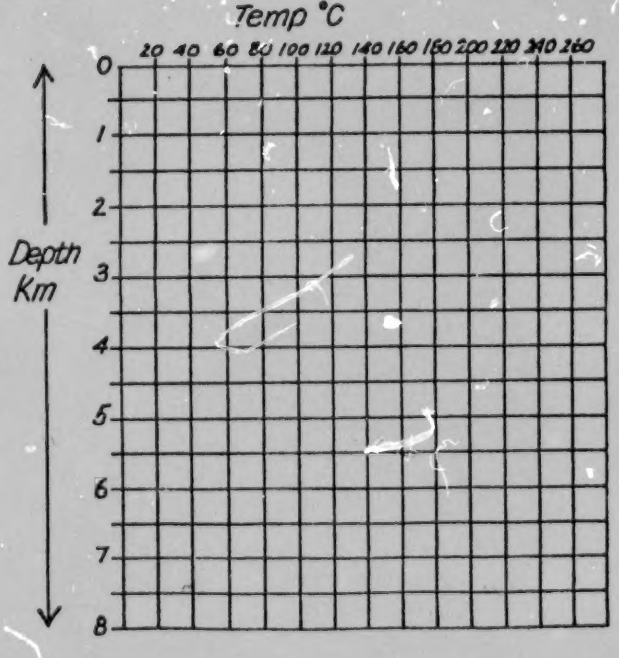
1. The following data was taken from a well, similar to an oil well drilled 8 km into the earth's crust. Graph this data just as you did for the sand.

2. The table shows that the greater the depth, the higher the temperature. Using the data in the table, calculate the average change in temperature (the temperature gradient) for each km in depth.

3. If this temperature gradient were continued to the center of the earth (about 6,350 km), how hot would it be there?___ °C.

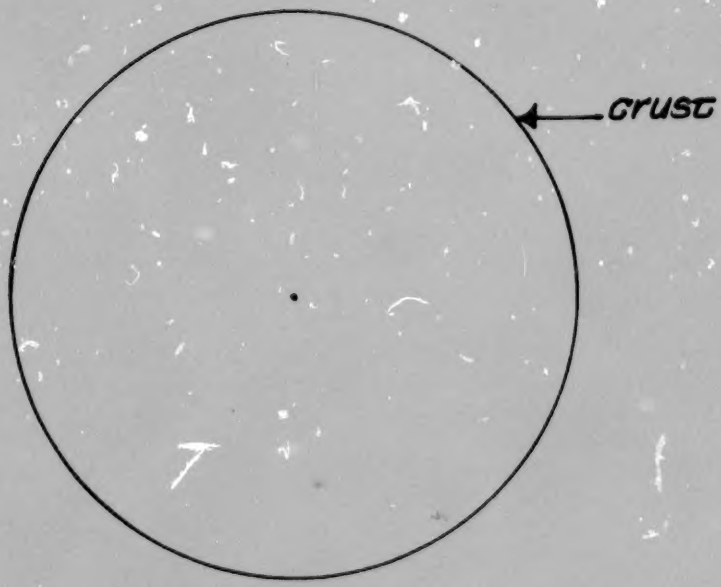
4. Actually, the temperature at the center of the earth is estimated to be 4,000 to 10,000°C. If we assume that the temperature at the center is 6,350°C, what is the temperature gradient from the surface to the center? _____ °C/km.

Depth Km	Temp °C
0	15°
1	51
2	88
3	120
4	151
5	179
6	205
7	232
8	257



The earth is made up of a central core with a radius of about 1,350 km. Surrounding this is a liquid core about 2,100 km thick. Between this and the crust is the mantle, and it is about 2,900 km thick. The crust averages about 35 km thick in continental areas and 6 km under the oceans. If the circle below represents the crust of the earth, draw circles to show the approximate size and position of the inner core, the liquid core, and the mantle, and label each.

The heat within the earth is called geothermal heat. What activities which occur at the earth's surface get their energy from this geothermal energy?



scale 1000 Km

0 1 2 3 5 6 7

Title: Energy On The Farm

Objectives: To develop an awareness of uses of fuel by farmers

Materials: Movie "TOAST" available (free loan) from Florida Power and Light Company and Governor's Energy Office

Copies of diagram - TYPICAL STAGES IN THE PRODUCTION OF BREAD on next page.

Procedure:

1. Involve students in an initial discussion on fuel use in producing food. Encourage them to think of all the ways in which fuel is used to get a loaf of bread to their homes. (You may need to supplement their ideas to expand horizons a bit, since many urban children know very little about agricultural practices.)

2. Show movie "TOAST" and discuss.

3. Read and Discuss the following:

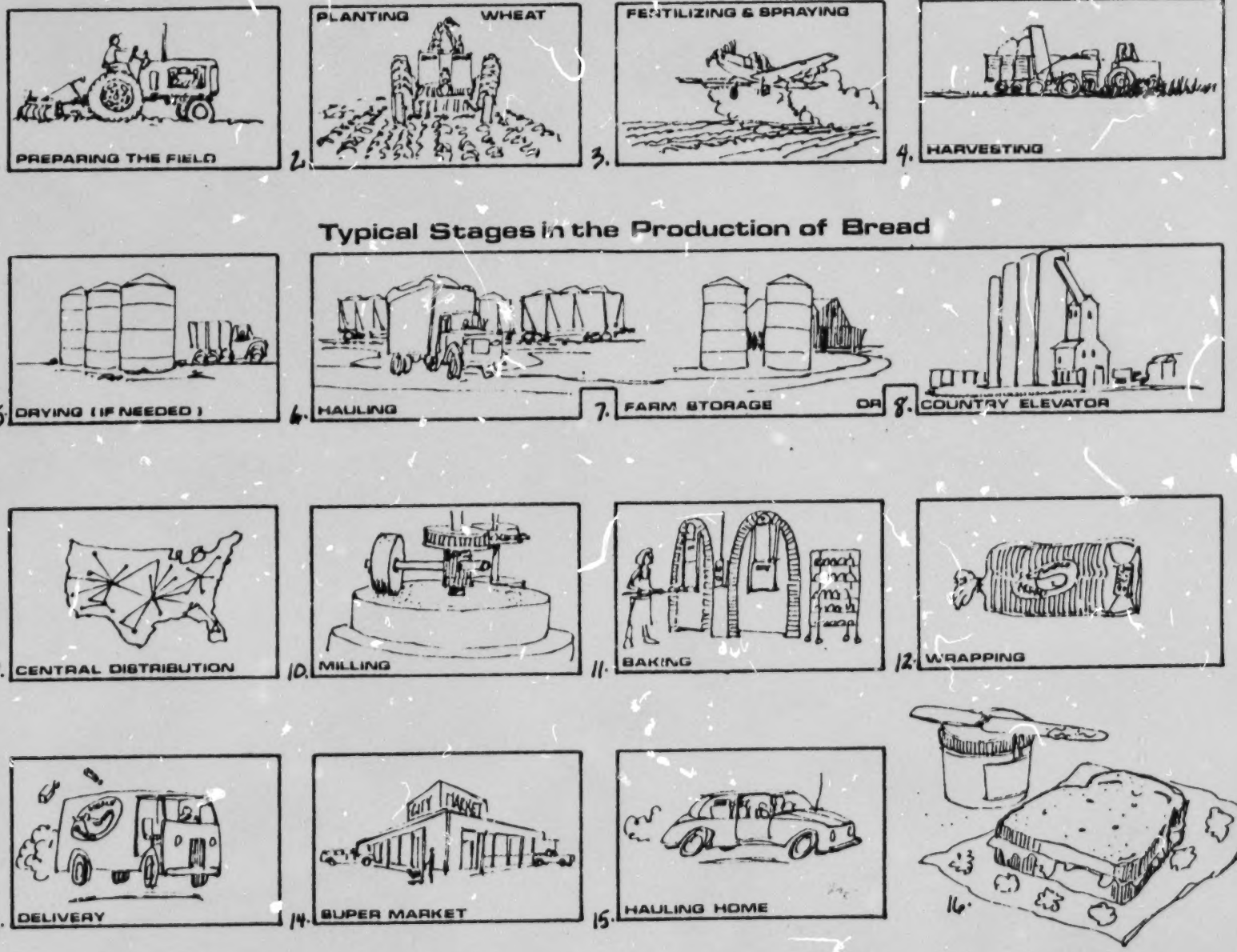
FOOD AND FUEL
AMERICAN SYSTEM UNITS

As petroleum products become expensive and increasingly scarce, many people are concerned about the crucial role of fuel in our food production and distribution systems. They note that a large part of the cost of our food is the result of large amounts of fuel used in both production and distribution. Our agriculture is highly mechanized, which requires fuel to run the machines, and our food is brought to us through long and complex chains of processing, handling, and transportation. As the supply of fossil fuels continues to diminish, many experts fear that one result will be higher prices for our food and possible shortages of items during periods when delivery could be interrupted by lack of fuel. With regard to prices, it is important to know that Americans spend a lower proportion of their income for food than do citizens of most other countries. We spend an average of less than 20% of our incomes for food, which is very low, but many people feel that this has been possible only because of cheap fuel.

In order to look carefully at the role of fuel in food production and distribution, let us follow the process involved in growing, harvesting, preparing, and delivering the wheat in a loaf of bread. It is a long journey, as you will see in the chart (on the next page), and fuel plays a part at every point in the journey.

4. Present the 15-step diagram on the next page to show students how complex the chain really is. Can they think of any major steps that have been omitted?

Typical Stages in the Production of Bread



Title: Lighting

Purpose: To identify ways in which energy is used in the school, to calculate how much energy is consumed in the school and school district, and to determine the amount and cost of water usage in the school

Materials: thermometer, candle, matches

Procedure:

1. Ask students how they think their school is heated. (gas, electricity, heating oil)

2. If they only guess, ask how they could find out. (Ask the principal or custodian.)

3. Now, ask how much energy they think the school uses a year.

   Explore all ways energy is used in the school -- heating, cooling, heating water, lunchrooms for cooking, science laboratories, lighting, shops, home economics, school buses, etc. Make a list on the chalkboard as students name them.

4. Ask how they could find out just how much energy is used.

5. Discuss reading the meters (you will want to check to determine if your school building has separate meters or if the district has a master meter), interviewing school officials, etc.

6. Divide the class into small groups.

   a. Ask two groups to be responsible for reading the gas and electric meters for one week. Have them record the reading on a master chart.

   b. Ask one group to interview an appropriate school official to determine how much energy the district uses in one year, and its cost. This group can calculate average cost per day and per building, roughly.

   c. One group can investigate the lighting in the school. Are lights left on unnecessarily? Are lights used when natural light is sufficient?

   d. Another group can check the accuracy of room thermostats. Is heating controlled in the room or is it centrally controlled? What is the temperature at the thermostat? at a desk in the center of the room? at a desk by a window?

e. Another group can check insulation, and check for drafts. First measure the room temperature in the center of the room; then at the outside wall. The difference should be about $5^{\circ}F$; if greater, there probably is inadequate insulation. Under your supervision, candles can be used to check for drafts around windows and doors. Ask the group to check to see if windows are opened in heated rooms, and if outside doors are left open, allowing warm air to escape.

f. One group could investigate the amount of water used in the school. Does the district have records to determine the cost of heating water?

7. When all the information has been collected, ask each group to write a report summarizing their data in graphs or charts. Have each group present the report to the class.

8. Then ask each group to plan an energy-efficient school. They could look at room and hall arrangement, door and window placement, lighting, water, ways to heat, etc. Again, the plan can be presented to the class.

9. As a final project, ask students to develop a conservation code for their school building and its inhabitants.

Title: Entropy

Purpose: To have students identify the origin of common breakfast foods and calculate the distances they were transported, and to determine ways to decrease transportation energy use

Materials:

Copies of "Where on Earth"? (on next page)
large wall maps of the United States and of the world
colored paper or marking pens
yarn
local map for local produce

Procedure

1. Discuss ways in which students could find out the origin of breakfast foods. For example: looking in encyclopedias, checking food packages, contacting the grocery store manager or produce stocker, talking to the County Extension Agent, a farmer, etc.

2. Perhaps a group of students could prepare a bulletin board entitled "Where on Earth?"

3. Have students complete the worksheet "Where on Earth"? Some research may be necessary to find out where foods are produced.

4. When this is completed, divide the class into small groups.

5. Appoint one group to compile the results from the entire class.

6. While they do this, another group can be making pictures of all of the breakfast foods. These will then be located on a wall map, and connected with a piece of yarn from the place of origin to the town in which you live.

7. Discuss students' reaction to the distances food is transported. Discuss ways the food may be transported, the cost, and the energy consumption involved.

8. Discuss why students think the food system includes extensive transportation and what eating habits were like before the invention of trains, cars, planes, etc.

9. Have them consider ways that energy use in transportation of food can be reduced.

WHERE ON EARTH?

Name _____

Class _____

Date _____

DIRECTIONS:

1. On the chart at the bottom of the page, list some of the foods you eat for breakfast. Or you may list a typical breakfast.

2. Find out where each of the foods was grown or raised. Keep in mind that many foods are transported from other parts of the country and the world. Some foods may be locally grown, but may not be in season. These are transported during the off-season.

3. When you have found out where the food is from, write the place down.

4. Then on the map provided (on next page), draw a picture of the food. Use colored markers to connect each food with a line to the town in which you live.

5. Calculate about how many miles each food item had to be transported to get to your breakfast table. Write it somewhere along the line you have drawn.

Name of Food	Origin of Food	Distance From Origin to Your Home Town

Title: Entropy

Purpose: To identify ways in which eating habits, food production and mealtimes differed in the past and to determine advantages and disadvantages between past and present food habits, production, and preparation

Materials: Copies of the questionnaire "What's New" (on the following page, to be reproduced for handout), tape recorders, if available

Before You Begin:

Interviewing grandparents or older community members is a great way to spark interest in the past, as well as provide a valuable learning experience. Before students begin this activity, present a lesson on interviewing and using tape recorders. Role-playing would also be helpful.

Procedure:

1. Read a selection from a book which describes a country feast or holiday meal. Or have students speculate on how eating habits, food production, food preparation, and mealtimes were different in the past.

2. Have each student select one or more persons (preferably grandparents or great-grandparents) to interview. If students do not know an older person they can interview, they may write to an older relative or go with another student.

3. Before starting the interviews, have each member of the class fill out the questionnaire themselves.

4. When questionnaires have been completed and returned, allow students to share what they learned. Small groups will work best because each student will get a chance to speak.

5. As a summary, have the class compare the results of their grandparents' questionnaire to their own. Discuss why they think eating habits, and methods of food production and preparation have changed. Consider the advantages and disadvantages of each way of life. Ask them to decide which way of life they prefer. Why?

WHAT'S NEW?

1. What did you eat for a typical

   a) breakfast?_____

   b) lunch?_____

   c) dinner?_____

   d) holiday meal?_____

2. What was a typical mealtime like? Who was there? How long did it last?_____
   _____
   _____

3. Where did you get your food?_____

4. How did you prepare the food?_____

5. What was the grocery store like?_____

6. What kind of packaging was used for food in the stored? At home?
   _____

7. What kinds of appliances did you use to prepare food?_____
   _____

8. Did you ever go out to eat? If so, where and when?_____
   _____

9. How do you think the food today compares with the food you ate when you were my age?

   a) convenience_____

   b) taste_____

   c) selection_____

   d) nutrition_____

10. Where did you grow up? How old are you? What is your name?
    _____
    _____

Title: Entropy

Objectives: To have students identify, through role-playing, conclusions as to what life would be like if transportation of food were severely curtailed

Materials:

1. Copies of "The Year 2000" appearing at the end of this lesson
2. Role-playing scenes -- written on slips of paper

Before You Begin:

1. You may want to divide the activity into two class periods, so that preparation is done during one class period and the actual role-playing during another class period.
2. The role-playing may be done simultaneously in small groups, or a group of individuals may volunteer to enact a scene while the rest of the class watches. If the former approach is chosen, the groups should contain no more than four or five students. Self-selection of groups may be important to the success of the role-playing activity. If the scene is enacted before the class, it is important that only students who volunteer be chosen for the scene enactment.

Procedure:

1. Give students the handout "The Year 2000." Read through the directions to make sure everyone understands them.
2. Allow time for background preparation.
3. Then provide time for the enactment of scenes. Two possible scenes are outlined. Scenes may be acted out in several different ways. Scene I stresses group problem-solving through a town meeting. Scene II involves spontaneous enactment in a grocery store. It is potentially a more volatile scene, though its lack of structure can provide insights into individual behaviour during circumstances of scarcity. You should decide on appropriate scenes and format for individual classes.
4. Immediately after the enactment of a scene, time should be provided for expression of feelings and ideas. Have the whole class meet for discussion and generalizing.

Discussion and Generalizing

Scene I

1. What roles were played in your scene?
2. How did you decide who would play each role?
3. Was there a leader? Who was it?
4. How did you decide the fruit would be distributed? Was this a fair decision? Was anyone left out?
5. Was there a restriction placed on the amount of fruit each person could have? If so, how did you decide it would be enforced? Is this a realistic decision?
6. How did you decide who got what kind of fruit?
7. Do you think anything like this could happen in real life?
8. What sacrifices would you be willing to make to ensure that there will not be an energy shortage that affects our food distribution?
9. How did you feel during the scene?
10. What did you learn?

Scene II

1. How do you feel right now?
2. How did you feel when the person in front of you got the last piece of fruit? What did you do about it?
3. Do you think it was fair that the government decided the fruit should be sold? Why or why not? How would you have handled it?
4. Was there a difference in how different players resolved the conflicts? (If the scene was role-played more than once.) What do you think accounts for this difference?
5. What did you learn about yourself? About other people?
6. Do you think anything like this could happen in real life?
7. Suppose a severe energy shortage did affect food transportation. How do you think the government would handle it? Do you think the decisions would be fair? Would certain groups be excluded?
8. What did you learn in this situation that can be applied to real life?

THE YEAR 2000

It is the year 2000. Rapid use of fossil fuels such as petroleum, natural gas, and coal has resulted in a severe energy shortage. Fuel must be saved for essential industry, preparing food, and operating hospitals. The government has made some new laws:

1. Food many not be transported from one state to another if the transportation uses fossil fuels.

2. No food may be imported from foreign countries.

You are to decide what life would be like in this new world. Use the following questions to guide you. You may also use books from the library or work we have done in class. Be complete in your preparation. We will be role-playing scenes which are based on your work.

Questions

1. What foods are available to you in Florida?

2. Are there any foods that you can no longer get?

3. Which foods from foreign countries are no longer a part of your diet?

4. What is happening to the price of food produced in Florida? In other states? In foreign countries?

5. What foods would you like to have that are available only in the neighboring states of Georgia, Alabama, and South Carolina?

Role - Playing

Read the following description. Then your teacher will select Scene I or Scene II to role-play.

> For Christmas a government official decides to send a crate of bananas, apples, pineapples, and other fruits to your town. There is enough for each person to have one piece of fruit. You have not had this fresh fruit for months and crave the taste.

Scene I

1. Representatives from the town meet to decide how to distribute the fruit.

2. Choose a mayor, a student, a business person, a parent, and a minister. You may pick any other roles, if you do not like these.

3. In fifteen minutes you must find answers to the following questions:

   a. How is the fruit going to be distributed? Will it be sold or given away?

b) Will there be a restriction on the amount of fruit each person can have? If so, how will it be enforced?

c) How will you decide who gets what kind of fruit?

Scene II

1. The city government has decided that the Christmas fruit will be sold on a first-come, first-served basis.

2. It has just been announced on the radio that there are apples for sale at the local grocery store.

3. You rush to the store. Remember, you must walk or ride a bike. The characters in this role-play are the checker, a person your age, a basketball player, a teacher, and the grocery store manager.

4. Suppose you are standing in line. The person in front of you gets the last apple. How do you feel? What will you be willing to do to get that apple?

Title: Brother Sun

Purpose: To construct a simple solar still that collects water from the soil.

Materials:

1 sheet of transparent heavy-duty plastic (e.g., 4 mil), 3' by 3' or larger, for each still
A tin can, cup or other suitable container to collect the water
Rocks (at the site) to weight down the plastic
A shovel, if necessary

Before You Begin:

1. Since operating times for the still vary considerable from place to place, you may want to make a test run before organizing the project for the class.

2. Assemble the necessary materials.

3. Students may work in small groups.

Procedure:

1. Initiate a general discussion about solar stills. Find out if students know how a solar still works. If not, define and explain the process evapotranspiration.

2. To build the still, choose a sunny day (it does not have to be warm, however). Find a suitable depression in the ground surface. Vegetation is not necessary, but will provide more water by evapotranspiration. If the terrain in your area does not provide a suitable depression, dig a hole 2' or more in diameter and about 1½' deep.

3. Set the can or other container at the bottom of the hole.

4. Cover the hole with the plastic and secure with rocks. The tighter the seal, the better the still will work.

5. Place a rock on the plastic directly above the can to aim condensed water into it. The steeper the plastic cone the more readily the water droplets will coalesce and drip into the can below.

6. Wait until water droplets form on the plastic and run down into the can. How long this takes and how much water is retrieved depends on the intensity of the sunlight, the moisture content of the soil, the evapotranspiration rate of any plants present, the size of the still, etc. In most situations, it will probably take several hours. The still could be left overnight if it is in a safe place.

7. After the demonstration, conclude the activity with a discussion. Some possible topics include:

   a. How does the still work?
   b. What is the survival value of this apparatus?
   c. Can you think of other designs for making a solar still?
   d. What uses could large-scale solar stills have?
   e. Where would solar stills find the most application? (geographic location)

8. Students could build stills of various sizes or in different materials and compare their performance.

Title: People Use The Sun

Purpose: To discover the relationship between the sun's energy and people's use of it

Materials: 2 cardboard boxes (same size), white paint or paper, 2 thermometers, plastic wrap, knife, masking tape

Procedure:

1. Cut a large hole in one side of both boxes.
2. Cover holes with plastic wrap.
3. Tape the wrap tightly over the holes.
4. Paint both boxes white, or cover them with white paper.
5. Place a thermometer in each box. Record the temperature in each box, and put them in the sun.
6. Record the temperatures after 10 minutes, 20 minutes, and 30 minutes. What do you find?
7. Ask: If you were designing a house in Alaska, on which side would you have the most windows? What about a house in Florida?
8. Try this experiment at different times during the day.
9. Does the time make any difference?
10. Add an overhang to both boxes.
11. Try different sizes of overhangs to see if it makes a difference.
12. How would the overhang affect the experiment at different times of the year?

Title: Autos, Autos, Autos

Purpose: To have the students determine how the individual, the government and industry influence the amount of energy used in a family, and to identify where energy conservation decisions could be made and what the advantages and disadvantages of these decisions would be

Materials: Duplicated copies of Case Studies 1 and 2 (on last pages of this lesson)

Activity 1. Case Studies

Before You Begin:

Either divide the class in half and give one case study to each half of give both studies to all the students.

The students could answer the questions individually. However, more interaction could be achieved through small group discussion.

Procedures	Commentary
What are some of the uses of energy in the case studies?	The energy uses are both direct (e.g., fuel for cars) and indirect (e.g., synthetic clothing).
How do decisions by the family, government, and industry influence the amount of energy used?	Family decisions include choosing to live in certain areas; job choice. Government decisions include the building of roads and busing decisions for students. Industry decisions include airline schedules and apartment central heating.
What are some of the benefits and costs of energy conservation?	Energy conservation can save money but requires investment; moving closer to work may save energy and give more free time, but may mean giving up a desired lifestyle.

ACTIVITY 2

Procedures	Commentary
Have students write brief "Energy Case Studies" for their own families. These cases can be duplicated for class reading and analysis.	Essays can include a description of all the energy used in the home by the family or how one person uses energy during the entire day. Students can recommend one way to save energy. They should explain some of the costs and benefits of this decision.
Some students may wish to devise a brief questionnaire to find out how and why they choose this method.	This questionnaire could include: How do you travel to work? Is there public transportation available? If there is, why do you use it or nor use it? What could be done to encourage you to use more public transportation? Do you drive a big or small car? Why?
Note: Students should be reminded if they do interview people, that the identity of people who are surveyed is kept confidential.	

CASE STUDY - 1

Mrs. W. is a traveling salesperson. She often travels over 100 miles a day. Sometimes she must carry displays. A big car makes this easier. She worries about the low gas mileage.

Occasionally, Mrs. W. must travel even longer distances. Since there are no trains, she takes a plane. In order to save money and fuel, the airlines have cut back on flights. This means that Mrs. W. must often stay overnight.

Mrs. W's children, ages 9, 11, and 15, travel a mile and a half to school. The youngest child gets bus service. To save money and energy, the school district does not provide bus service for junior or senior high students. Most of the time Mr. W. drives all three children to school in the family's second car.

The family lives in a large, old home. Although it stays cool in the summer, it is difficult to heat in the winter. More insulation would reduce fuel bills, but costs money.

1. List as many examples of energy use in the story as you can.

2. What decisions made by the family influence the amount of energy they use?

3. What decisions made by the government influence the amount of energy used by the family?

4. Name one way that the family could conserve energy.

5. Besides saving energy, what benefits would they get from this decision?

6. What changes in their life would the family have to make if they were to save energy in this way?

CASE STUDY - 2

Mr. C. likes living in a big city. He teaches school in one of the suburbs twenty miles from where he lives. The only train that gets Mr. C. to school on time leaves at 6:15 a.m. Instead, he drives his small car to work.

The drive to work is easy. He crosses a toll-free bridge and drives on a major highway. The bridge and the highway were built by the state and federal governments.

After school, Mr. C. coaches basketball. This means that he can't drive to and from work with other teachers who live near him in the city.

The students in Mr. C's class sometimes get angry when he turns the heat down.

At his apartment, the heat is controlled by the building managers. It gets so hot in the winter that Mr. C. leaves the windows open.

Mr. C. has two children, ages 12 and 14. Both go to school in the city. They travel to school by subway.

1. List as many examples of energy use in the story as you can.

2. What decisions made by the family influence the amount of energy they use?

3. What decisions made by industry influence the amount of energy used by this family?

4. Name one way the family could conserve energy.

5. Besides saving energy, what benefits would they get from this decision?

6. What changes in their life would the family have to make if they were to save energy in this way?

Title: Energy To Get Energy

Objectives: To have students become aware of the great distances that energy resources are transported

Materials:

Copies of BLUE WATER, BLACK GOLD (on the following page)
Map(s) of the world and atlas
Marking pens

Procedure:

1. After a general discussion of the transportation of oil, ask students to read "Blue Water, Black Gold."

2. Ask students to locate the places mentioned in the reading on a world map. They may need to use an atlas. They can also draw in the route normally taken by the "Cybele" and calculate its distance according to the map's scale.

3. Ask students to pretend that they are aboard the "Cybele" on a trip to Kuwait; they can pretend to be any person aboard - the captain, first mate, radar technician, cook, stowaway, etc. Ask them to describe a day aboard ship. They may do further research or make their descriptions purely from imagination.

4. If desired, students can choose roles and role-play life aboard ship. Ordinary or crisis situations such as faulty equipment, heavy seas, leaking hold, blockade, or boarding by "pirates" (still a problem in some parts of the world) are suggested.

5. If desired, students can develop their own math problems from the reading and conduct a math game. Divide the class into small groups. Each group makes up five math problems (and answers). Put all the problems into a hat, then each group draws out five at random. The groups then attempt to be the first to correctly answer their five problems.

6. Ask students to do further research on the topics of oil importation or oil tankers. These topics can lead into many others such as economics and regulation. Students can make individual or group reports or presentations.

BLUE WATER, BLACK GOLD

Our writer interviewed a ship's captain who sails for Gulf Oil. Although his name and the ship's name have been changed, the following account is a summary of the interview.

Captain Ishmael Jones, who commands the moderate-sized oil tanker, "Cybele," enjoys the astonishment of landlubbers who do not realize that the United States has several great inland waterways. The Great Lakes and Mississippi River are obvious on a map, but almost unknown is the enormously long Intercoastal Canal waterway which allows a ship to travel almost entirely inland, beginning at Brownsville, Texas, on the Rio Grande, to proceed across Texas mainly inland, cross several natural bays, traverse the Mississippi, and go on through Mobile Bay and Pensacola Bay in Florida. If she wishes to continue up the East Coast, she goes slightly outside of land around to Port St. Joe, Florida, and then enters a canal-waterway system that will allow her to travel inland north to Chesapeake Bay and into Delaware Bay by the Delaware Canal. If a ship at that point wishes to continue north, she must take to the sea.

Captain Jones, however, usually transports oil from the Persian Gulf to either the East or the West Coasts of the Americas. He might load up at Mina al Amadi, Kuwait, at the head of the Persian Gulf. If his destination is the refining area of Texas, he will sail 15,250 miles down around Africa and across the Atlantic. Tankers such as his are loaded directly through a form of flexible pipeline which can vary in size from 3 inches to 24 inches. They normally load 100,000 barrels an hour at 100 pounds per square inch (psi) pressure through an average size pipe. His ship normally carries 2,300,000 barrels. When the ship arrives near her destination, smaller vessels come out to start unloading it. His ship can enter many ports after it is lightered in this way. However, really large supertankers must be unloaded entirely by lightering, and can enter only a few ports in the entire world.

The trip from the Persian Gulf Takes 30 to 32 days. Sometimes, personnel can be changed off Africa by using helicopters or launches. The crew for such a large ship averages only about 31 men and women, who are all highly trained technicians. Such a ship can only be managed through a great deal of automation. To alleviate any boredom that might arise, there is a swimming pool, gymnasium, and video cassettes, as well as activities the crew organizes. Food becomes very important, and meals are elaborate and well-prepared.

The crew is given as many days off as they have been at sea. Thus, the average working year is aroung 6½ months. After three years of training at one of several maritime academies around the country, the man or woman receives either a third mate or a third engineer certificate, and starting salaries are around $35,000 per year. Officers make considerable more. It is possible to start as an unskilled ship person, but rather unusual there days. Captain Jones states that his company in particular, and many other companies, are anxious to hire more women in the field.

Captain Jones also reports that the captain is no longer expected to go down with the ship, and that he has sailed through the Bermuda Triangle an endless number of times without even seeing a mermaid or UFO.

Title: Energy To Get Energy

Purpose: To have students become aware of the stages involved in energy production and distribution from original resource to consumers

Procedure:

1. Have students work in teams, as individuals, or both.

2. Ask students if they know what steps oil must go through in order to reach a service station as gasoline. Explain that the purpose of this activity is to select a variety of products (gasoline, natural gas, unit of electricity) and to learn the stages of transportation for that product.

3. Ask students to decide on a product to trace.

4. Give the following directions:

   a. Go to or call the first contact you can make concerning your product, such as the local gasoline station.

   b. Using that information, go back another step in the process and find out where the distributor obtained the gasoline, or natural gas, etc.

   c. Be stubborn. Be willing to write letters or make telephone calls when the distribution chain gets farther away from your location.

   d. Try to find out the specific dealer and talk with or write to them. Try to get information on what their costs are at each point.

5. During this process, the team or individual should be keeping good notes or even mapping the progress they are making.

6. When the project data is completed, have students make a large map which shows the results of the entire project.

7. During class discussion, bring up such points as what research skills were developed. Include the ability to talk to others, write letters, use the library, and so forth. Was one company more cooperative than another? Did anyone's energy source converge on a product someone else was tracking? What was learned about costs? What was learned about transportation? Was one mode of transportation more common than another? How many modes of transportation were used? How many times was a product moved? How many times did its ownership change hands? Where did the chains stop? Was everyone able to follow through from source to consumption? If not, why not?

Title: Energy Use In The U.S.

Purpose: To have students understand the importance of using EnergyGuide Labels for comparison shopping

Materials: Duplicated copy for each student:

Using EnergyGuide Labels For Comparison Shopping

EnergyGuide Model A, Model B

EnergyGuide (air conditioner)

EnergyGuide (dishwasher)

Worksheet, three copies for each student

Procedure:

1. Give students copies of worksheets and Energy Guides.
2. Read aloud and discuss "Using Energy Guide Labels for Comparison Shopping."
3. Do exercises as directed.

USING ENERGY GUIDE LABELS FOR COMPARISONS SHOPPING

If you have to choose between two appliances with the same features, capacities, and price, but with different annual energy costs, then obviously you are better off buying the one with the lower annual energy cost (the more energy efficient model). In this case, you can simply look at the big number on each label, see which is lower, and take that model with you.

However, the purchase price of the energy efficient model may be higher than the price of the standard model. (This is because extra insulation and more efficient motors often cost more.) But think again: the lower energy cost of the energy efficient model will usually make up for its higher purchase price. The question, then, is how to figure out which model will cost you less in the long run.

Look at the worksheet that shows you how to use the EnergyGuide Label to decide whether you are better off buying a model with a higher purchase price but lower annual energy cost. For example, you can use the worksheet to compare the two refrigerator-freezers whose labels and prices are provided.

First, you need to fill in the answers to the questions on the top half of the worksheet.

1. Are the appliances comparable in size and features? As you recall, to find the capacity of the model, look just above the word "EnergyGuide" on the left hand side of the label. The refrigerators in this example are both about 17 cubic feet, and the features given on the top right side of the labels are the same, so the answer to the first question is "yes."

2. What is the purchase price of the energy efficient model? What is the price of the standard model? The energy efficient model is the one with the lower yearly energy cost (or, in the case of air conditioners, the higher energy efficienty rating). As you can see, the label of the Model A shows an average yearly cost of $51; the label on the Model B, a cost of $70. In this example, therefore, Model A is the more energy efficient appliance, and Model B is the standard model. Now look at the price tags of the two refrigerators. The energy efficient model is priced at $545 and the standard model at $485. (If you wanted to, you also could add sales tax and delivery charges, if any, to the price of each model.) Which, then, has the lower total cost? This depends on...

3. How often will you use the product? This question does not apply to refrigerators, freezers, and water heaters, which run continuously. However, you will need to answer this question for clothes washers, dishwashers, and room air conditioners, since these are appliances that some people use often but others use seldom.

4. What is your local energy rate? Assume, for this example, that your local electricity rate is 5.4¢ / KWH. Because the grid on the label gives costs in intervals of 2¢, you will need to round off the rate, in this case, to 6¢ / KWH.

How much will each model cost you to run annually, based on your local energy rate? If you look at 6¢ / KWh on the cost grids, you can see that the standard model will cost you approximately $85 per year and the energy efficient model will cost you approximately $62 per year to run.

5. How long do you expect to keep the appliance? The average life of a refrigerator-freezer is approximately 15 years as shown in the table below. However, assume for this example that you will move in 10 years and leave the appliance behind.

AVERAGE LIFE EXPECTANCY OF NEW APPLIANCES

Appliance	Expected lifetime (years)
Refrigerators and refrigerator-freezers	15
Freezers	18-20
Dishwashers	11
Clothes Washers	11
Water heaters	10-12
Room air conditioners	12-15
Furnaces	20

SOURCE: Based on averages from Home Economics Research, March 1975, p. 169, and Department of Energy estimates.

Once you have answered these five questions, you can figure out whether you are better off buying the more energy efficient appliance by performing the calculations on the bottom half of the worksheet.

Step 1.

As shown on the worksheet, you first need to calculate the difference in purchase price between the two appliances by subtracting the cost of the standard model ($485) from the cost of the more energy efficient model ($545). The price difference in this case is $60.

Step 2.

Next, estimate the amount of money you will save each year with the more energy efficient model by subtracting the operating cost of the standard model. In this example, since refrigerator-freezers run continuously, you just need to know the local energy rate in order to identify Model A's and Model B's yearly operating costs. Thus, at a 6¢ / KWH rate, Model A's yearly operating cost would be $62, Model B's yearly operating cost would be $85, and your yearly savings would be $23 ($85 - $62 = $23).

Step 3.

You can then calculate the total amount of money you will save in operating costs over the years with the more energy efficient appliance by multiplying the yearly cost by the number of years you expect to keep the appliance (10 years). This gives you the total operating costs for the life of the appliances: Model A's total operating cost would be $620, Model B's would be $850. The difference between the two appliances' total operating costs gives the total savings in operating cost, $230.

Step 4.

The total cost to you is the purchase price plus the total operating cost over the life of the appliance. Add the purchase price and total operating cost for Model A ($545 + $620 = $1165) and for Model B ($485 + $850 = $1335) and find the difference or total savings. Thus, the total savings in this example is $170 over 10 years; that is, by paying an extra $60, you can save a net $170 in energy costs if you keep the appliance for 10 years.

Step 5.

Finally, you can figure out how soon you will recover the extra $60 you have to pay for the more energy efficient appliance by dividing the price difference ($60) by the annual energy cost savings ($23). In this case, it would take you about 2-½ years to break even with the higher priced but more efficient model.

In summary, you can use the energy cost information on the label to determine:

- which appliance costs less to run; and
- whether you are better off buying an appliance with a higher initial purchase price but lower annual energy cost.

Now you try it on your own. You can compare the two room air conditioners or dishwashers whose labels and prices are provided, or, better yet, compare two you find in the marketplace! But remember: with clothes washers, dishwashers, and room air conditioners, all of which do not run continuously, you will need to know both the local energy rate and how often the appliance is used (expressed in loads per week or yearly hours of use) before you can identify their yearly operating costs on their labels' cost grids. Once you know this, you do the same calculation as you did with Models A and B to determine the total cost savings.

WORKSHEET

HOW TO FIGURE WHETHER THE ENERGY EFFICIENT MODEL IS A BETTER BUY FOR YOU

	Model B Standard Model	Model A Energy-Efficient Model	Difference
Step 1.			
Purchase Price	$ _____	$ _____	$ _____
Step 2.			
Yearly Cost (from appliance label)	$ _____	$ _____	$ _____
Step 3.			
How many years do you expect to keep it?	_____ yrs.	_____ yrs.	
Total Operating Cost (Multiply Yearly Cost by number of years you will keep it)	$ _____	$ _____	$ _____
Step 4.			
Total cost to you (Add Purchase Price and Total Operating Price)	$ _____	$ _____	$ _____

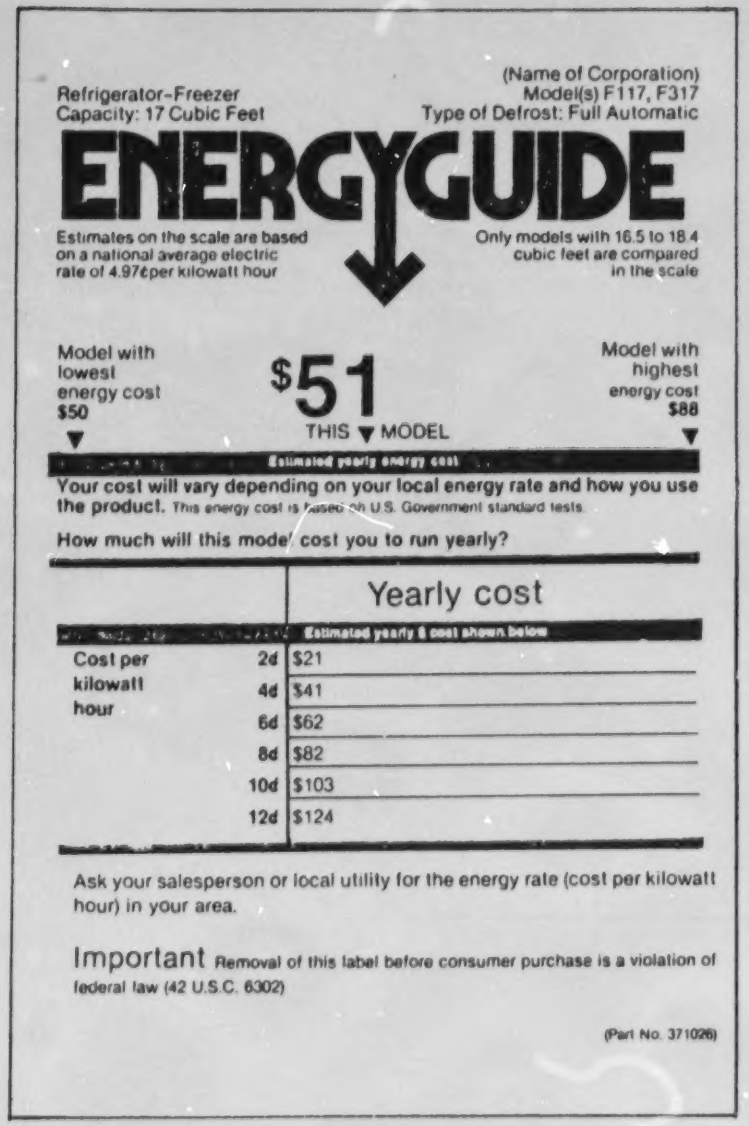
Step 5.

To figure how long it will take to recover the extra cost of the energy efficient model, divide the difference in price from line 1 by the difference in yearly operating cost from line 2.

Difference in purchase price ÷ Difference in yearly cost = Years to Recover

$ _____ ÷ $ _____ = _____yrs.

MODEL A
Cost: $545.00



Refrigerator-Freezer
Capacity: 17 Cubic Feet

(Name of Corporation)
Model(s) F117, F317
Type of Defrost: Full Automatic

ENERGYGUIDE

Estimates on the scale are based on a national average electric rate of 4.97¢per kilowatt hour

Only models with 16.5 to 18.4 cubic feet are compared in the scale

Model with lowest energy cost $50

$51 THIS MODEL

Model with highest energy cost $88

Estimated yearly energy cost

Your cost will vary depending on your local energy rate and how you use the product. This energy cost is based on U.S. Government standard tests.

How much will this model cost you to run yearly?

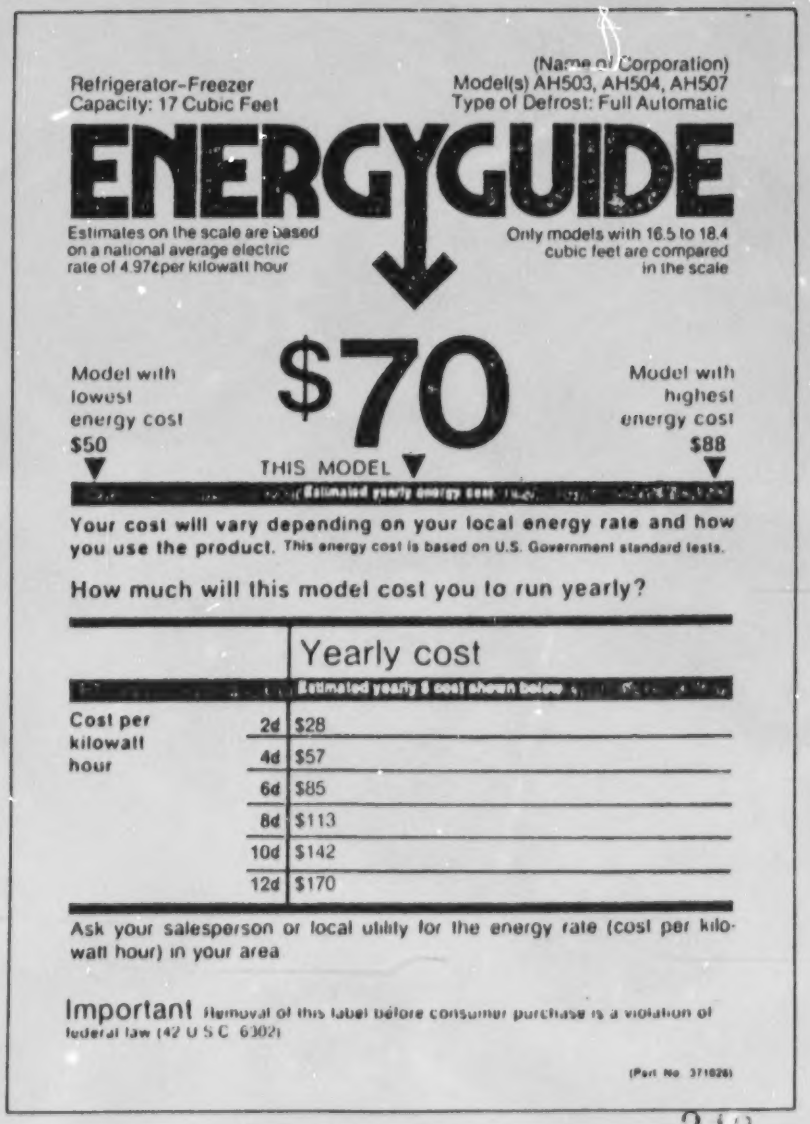
		Yearly cost
		Estimated yearly $ cost shown below
Cost per kilowatt hour	2¢	$21
	4¢	$41
	6¢	$62
	8¢	$82
	10¢	$103
	12¢	$124

Ask your salesperson or local utility for the energy rate (cost per kilowatt hour) in your area.

Important Removal of this label before consumer purchase is a violation of federal law (42 U.S.C. 6302)

(Part No. 371026)

MODEL B
Cost: $485.00



Refrigerator-Freezer
Capacity: 17 Cubic Feet

(Name of Corporation)
Model(s) AH503, AH504, AH507
Type of Defrost: Full Automatic

ENERGYGUIDE

Estimates on the scale are based on a national average electric rate of 4.97¢per kilowatt hour

Only models with 16.5 to 18.4 cubic feet are compared in the scale

Model with lowest energy cost $50

$70 THIS MODEL

Model with highest energy cost $88

Estimated yearly energy cost

Your cost will vary depending on your local energy rate and how you use the product. This energy cost is based on U.S. Government standard tests.

How much will this model cost you to run yearly?

		Yearly cost
		Estimated yearly $ cost shown below
Cost per kilowatt hour	2¢	$28
	4¢	$57
	6¢	$85
	8¢	$113
	10¢	$142
	12¢	$170

Ask your salesperson or local utility for the energy rate (cost per kilowatt hour) in your area

Important Removal of this label before consumer purchase is a violation of federal law (42 U.S.C. 6302)

(Part No. 371026)

$350

Room Air Conditioner
Capacity: 6,000 BTU/hr.

(Name of Corporation)
Model(s) SA 714, SA 718

ENERGYGUIDE

Models with the most efficient energy rating number use less energy and and cost less to operate

Models with 5,200 to 7,699 BTUs cool about the same space

Less efficient model 5.6

7.3 THIS MODEL

Most efficient model 10.2

Energy Efficiency Rating (EER)

Your cost will vary depending on your local energy rate and how you use this product. This energy cost is based on U.S. Government standard tests.

How much will this model cost you to run yearly?

Yearly hours of use		250	750	1000	2000	3000
		Estimated yearly $ cost shown below				
Cost per kilowatt hour	2¢	$6	$17	$22	$44	$66
	4¢	$11	$44	$66	$88	$132
	6¢	$17	$50	$66	$132	$198
	8¢	$22	$66	$88	$176	$264
	10¢	$28	$83	$110	$220	$330
	12¢	$33	$99	$132	$264	$396

Ask your salesperson or local utility for the energy rate (cost per kilowatt hour) in your area.

Important Removal of this label before consumer purchase is a violation of federal law (42 U.S.C. 6302)

(Part No. 20648)

233

243

$300

Room Air Conditioner
Capacity: 6,000 BTU/hr.

(Name of Corporation)
Model(s) AR600[illegible]

ENERGYGUIDE

Models with the most efficient energy rating number use less energy and and cost less to operate

Models with 5,200 to 7,699 BTU's cool about the same space

Less efficient model 5.6

5.7 THIS MODEL MODEL

Most efficient model 10.2

Energy Efficiency Rating (EER)

Your cost will vary depending on your local energy rate and how you use the product. This energy cost is based on U.S. Government standard tests.

How much will this model cost you to run yearly?

Yearly hours of use		250	750	1000	2000	3000
		Estimated yearly $ cost shown below				
Cost per kilowatt hour	2¢	$5	$16	$21	$42	$63
	4¢	$11	$32	$42	$84	$126
	6¢	$16	$47	$63	$126	$189
	8¢	$21	$63	$84	$168	$252
	10¢	$26	$79	$105	$210	$315
	12¢	$32	$95	$126	$252	$378

Ask your salesperson or local utility for the energy rate (cost per kilowatt hour) in your area.

Important Removal of this label before consumer purchase is a violation of federal law (42 U.S.C. 6302)

(Part No. 20648)

241

$250

Dishwasher
Capacity: Standard

(Name of Corporation)
Model(s) MR328, XL12, NA83

ENERGYGUIDE

Estimates on the scale are based on a national average electric rate of 4.97 ¢ per kilowatt hour and a natural gas rate of 36.7 ¢ per therm

Only standard size dishwashers are used in the scale

Electric Water Heater

Model with lowest energy cost $62 — **$73** — Model with highest energy cost $92 — THIS MODEL

Estimated yearly energy cost

Gas Water Heater

Model with lowest energy cost $26 — **$31** — Model with highest energy cost $40 — THIS MODEL

Estimated yearly energy cost

Your cost will vary depending on your local energy rate and how you use the product. This energy cost is based on U.S. Government standard tests.

How much will this model cost you to run yearly?

with an electric water heater

Loads of dishes per week		2	4	6	8	12
Estimated yearly $ cost shown below						
Cost per kilowatt hour	2¢	$7	$15	$22	$29	$44
	4¢	$15	$29	$44	$59	$88
	6¢	$22	$44	$66	$88	$132
	8¢	$29	$59	$88	$117	$176
	10¢	$37	$73	$110	$146	$220
	12¢	$44	$88	$132	$176	$264

with a gas water heater

Loads of dishes per week		2	4	6	8	12
Estimated yearly $ cost shown below						
Cost per therm (100 cubic feet)	10¢	$4	$8	$12	$16	$24
	20¢	$5	$11	$16	$22	$33
	30¢	$7	$14	$21	$28	$41
	40¢	$8	$17	$25	$33	$50
	50¢	$10	$19	$29	$39	$58
	60¢	$11	$22	$34	$45	$67

Ask your salesperson or local utility for the energy rate (cost per kilowatt hour or therm) in your area, and for estimated costs if you have a propane or oil water heater.

Important Removal of this label before consumer purchase is a violation of federal law (42 U.S.C. 6302)

Part No. (73906)

$230

Dishwasher
Capacity: Standard

(Name of Corporation)
Mo Model(s) CD1814, CL1950

ENERGYGUIDE

Estimates on the scale are based on a national average electric rate of 4.97 ¢ per kilowatt hour and a natural gas rate of 36.7 ¢ per therm

Only standard size dishwashers are used in the scale

Electric Water Heater

Model with lowest energy cost $62 — **$89** — Model with highest energy cost $92 — THIS MODEL

Estimated yearly energy cost

Gas Water Heater

Model with lowest energy cost $26 — **$38** — Model with highest energy cost $40 — THIS MODEL

Estimated yearly energy cost

Your cost will vary depending on your local energy rate and how you use the product. This energy cost is based on U.S. Government standard tests.

How much will this model cost you to run yearly?

with an electric water heater

Loads of dishes per week		2	4	6	8	12
Estimated yearly $ cost shown below						
Cost per kilowatt hour	2¢	$9	$17	$26	$35	$52
	4¢	$17	$34	$52	$69	$103
	6¢	$26	$52	$78	$104	$156
	8¢	$34	$69	$104	$138	$207
	10¢	$43	$87	$130	$173	$260
	12¢	$52	$104	$156	$208	$312

with a gas water heater

Loads of dishes per week		2	4	6	8	12
Estimated yearly $ cost shown below						
Cost per therm (100 cubic feet)	10¢	$5	$10	$15	$19	$29
	20¢	$7	$13	$20	$26	$39
	30¢	$8	$17	$25	$33	$50
	40¢	$10	$20	$30	$40	$60
	50¢	$12	$24	$35	$47	$71
	60¢	$13	$27	$41	$54	$81

Ask your salesperson or local utility for the energy rate (cost per kilowatt hour or therm) in your area, and for estimated costs if you have a propane or oil water heater.

Important Removal of this label before consumer purchase is a violation of federal law (42 U.S.C. 6302)

Part No. (73906)

Title: Limits to Electric Power

Purpose: To understand that public energy consumption is generally based on socio-cultural factors

Concept: Energy, its production, use, and conservation are essential in the maintenance of our society as we know it.

Procedure:

1. Locate on a city map the numbers and types of street lamps. (Do for a small area and extrapolate.)

2. Find out from your local utility company how much electricity is required for various kinds of street lights.

3. Calculate the costs for operating these lights over a year's time.

4. Compare this cost of operation to cost for heating an average home.

5. Have students find out from the city planners why the street lights were placed there and the reasons for the number and pattern. They might also find the crime statistics for the area. Any discussion on the crime rates must also be associated with other socio-economic problems of the area.

6. Discuss:

   a. Could the layout (pattern) of lighting be changed and the numbers reduced?

   b. Do you have a streetlight near or in front of your house?

   c. Do you have security lighting in your yard or attached to your home?

   d. Should the lights be on all night?

   e. Do they really serve as a crime deterrent?

   f. Wouldn't carrying flashlights serve the same purpose?

Title: Limits To Electric Power

Purpose: To examine energy usage in the public water supply

Procedure:

1. Contact your water department to secure a topographic map(s) of the area that includes the city water filtration-pumping station and the residences of the students in the class. Involve the students in learning how to read elevation levels on a topographic map and ask each student to determine the difference in elevation between the pumping plant and his home. (Homes will almost always be higher than the pumping plant.)

2. Ask each student to obtain from his/her parents a record of the amount of water used in the home during the past three or six months. The weight of water used can be calculated since one cubic foot weighs 62.5 pounds. The height the water was lifted is known from the elevation differences found on the topographic map(s).

3. Since work can be measured in ft/lbs, the elevation difference times weight of water used equals the minimum work done to deliver water to the family. Review other factors that would increase this amount (e.g., friction, height of water supply standpipe, and others).

4. Compare results obtained for each household.

   a. Which one required more energy to have its water delivered?

   b. Why?

   c. Is wasting water also wasting energy?

   d. What are some very obvious ways to save water and thus electricity?

Title: Limits To Electric Power

Purpose: To enable students to isolate energy consuming steps in the food system and to speculate as to the different ways in which energy could be saved

Procedure:

1. Discuss these twelve areas in a food system for a frozen vegetable. Which steps could be eliminated to save energy?

   a. Someone else grows a vegetable
   b. Transports it to a processing plant
   c. It is sliced by machine
   d. It is packaged
   e. It is frozen
   f. Refrigerated truck takes it to market
   g. Market keeps it frozen
   h. You drive to market to buy it
   i. Take home and put in freezer
   j. Thaw it and cook it
   k. Throw away package
   l. Eat it

2. How could you personally change or eliminate any of these 12 steps?

3. What steps do you personally take to get this vegetable?

4. What kinds of other people are involved in getting this vegetable to you?

5. Discuss the energy use required by each step.

6. Which steps could be eliminated to save energy?

7. Are there alternatives which are more energy conserving?

8. Construct the food chain steps for a canned soft drink and then make suggestions for steps which might be eliminated to save energy.

Title: Life With Limited Energy

Purpose: To have students identify areas in the economy where energy savings could be made

Objectives: Changes in technology and lifestyles, while requiring some present tradeoffs and investments, may save energy for future needs. The students should be able to:

1. Identify sectors of the economy where major savings could be made in energy.

2. Identify some of the social and economic costs and benefits of conservation measures.

Activity 1

Procedures:

1. Brainstorm with the students all the ways they can think of that they might save energy today. How could they save energy directly? How could they save energy indirectly?

   For example:

   Direct: Walk to school rather than drive; turn lights out; turn the heat down; eat untoasted bread; wash in cold water; not play a radio or T.V.; use a regular toothbrush.

   Indirect: Wear natural, rather than synthetic, clothes; not waste food; not waste paper.

2. Why might they choose (or not choose) to conserve energy in this way?

3. Which of these choices were under their control? Which of the choices were under the control of the parents or other authorities?

4. Which of these savings would be easy to make; which difficult? Why?

5. Would people of different economic levels have the same or different difficulties in making these choices?

Title: Life With Limited Energy

Purpose: To provide students with an understanding of (1) how the amount of electricity used in the home is measured, and (2) the differences in energy requirements and operation costs of various household appliances

Materials: Copies of AVERAGE WATTAGE OF ELECTRICAL APPLIANCES (next page)

Procedure:

1. Define the terms needed to understand the measurement of electricity consumption in the home (watt, kilowatt, kilowatt hour). From an electric company bill, determine the average cost of a kilowatt-hour (KWH) for your area. Have students examine the table of "Average Wattage of Electrical Appliances", and then compute what it costs in their own homes to:

   a. Leave a 100-watt light bulb burning for 6 hours
   b. Use the vacuum cleaner for 2 hours
   c. Use all burners of the oven and range for 3 hours
   d. Use a dishwasher for 1 hour every day for 30 days
   e. Run an electric clock for 1 year.

2. A variety of other simple calculations (appropriate for the class) should be devised to illustrate the relative cost of household appliances.

3. Have students list all the electrical appliances in their homes. What appliances consume the most energy? What ones consume the least? Are these appliances necessary or simply luxuries? What can we do to conserve energy and decrease household costs?

ACTIVITIES TO BE COMPLETED AT HOME

4. Have students check the wattage of the light bulbs and fluorescent bulbs in their houses, and estimate the number of minutes or hours that they are used each day. Have them calculate the cost of lighting their home for one evening, one month, and one year.

5. If previous electric bills are available, have students construct a graph to show the monthly cost of electricity consumed in their homes over the past 12 months. Is there a significant variation in the cost per month? Which months are most expensive? Why?

6. Have students record the reading on their electric meter at the same time each day for one week (or one month). Plot a cumulative graph (and histogram) to illustrate electricity consumption (KWH) over a period of time. is more electricity consumed on some days than on others? Why?

AVERAGE WATTAGE OF ELECTRICAL APPLIANCES
1000 Watts = 1 Kilowatt

Appliance	Average Wattage
Bottle Warmer	400
Broiler	1325
Clothes Dryer	4600
Clock	2
Coffeemaker (Automatic)	830
Cooker (Egg)	520
Dehumidifier	230
Dishwasher (With heat unit)	1155
Dishwasher (No heat unit)	290
Disposal (Only)	330
Fan, Attic	370
Fan, Desk	70
Fan, Furnace	225
Fan, Ventilating	85
Floor Polisher	240
Grill	770
Hair Dryer	235
Heat Lamp (Infrared)	250
Heater, Radiant	1095
Hot Plate	1140
Mixer, Food	130
Oil Burner	245
Percolator	490
Radio	90
Radio-Phonograph	100
Razor	15
Sewing Machine	75
Television	280
Toaster	1000
Vacuum Cleaner (Tank Type)	375
Vibrator	45
Waffle Iron	855
Washer	280
Water Pump	265

These appliances are usually controlled by thermostats which permit the flow of electricity for intermittent periods only:

Electric Blanket	180
Heating Pad	55
Food Freezer (8 cu. ft.)	125
Iron	1,000
Ironer	1,500
Range	12,000*
Refrigerator	205
Room Cooler (Window Type)	400
Roaster	1,300
Water Heater (66 gallons)	3,250

*This includes total wattage of all the burners and oven of the range.

Title: Life With Limited Energy

Purpose: To become more aware of energy costs in family budgets.

Materials: Copies of "Annual Household Energy Budget in Mid-1973"

Procedure:

1. Make available to every child the "Annual Household Energy Budget" shown on next page. Ask that each child review, as homework with his parent(s), the data shown in the table. Specifically, parents should be asked to indicate where their energy expenditures exceed or fall below the dollar values indicated.

2. Ask parents to estimate how much the family's uses of energy have increased since the chart was made. Prepare a chart showing present uses.

3. Organize the data returned by children into a large chart on the chalkboard to determine where the families represented by the students use more or less energy than the average family.

   a. What factors are responsible for the differences that may appear?

   b. Are parents worried about the increasing cost of energy?

   c. What are they doing to save energy costs in the family budget?

AVERAGE ANNUAL HOUSEHOLD ENERGY BUDGET IN MID-1973

ENERGY END USE	FORM OF ENERGY	ENERGY PER YEAR		(d) DOLLAR VALUE $)	EQUIVALENT AMOUNT OF GASOLINE (Gallons)
		Percent	Million Btu		
Automobile	Gasoline	28.2	113.9	344.63	911
Space Heating	Natural Gas, Oil & Elect.	27.8	112.1	165.65	897
Major Appliances	Electricity	2.7	11.0	76.20	88
Water Heating	Natural Gas, Oil & Elect.	6.2	25.1	48.25	201
(a) Air Cond.	Electricity	1.6	6.6	45.78	53
Lighting & Other Electrical	Electricity	1.4	5.7	39.07	46
(b) Miscellaneous Household & Recreation	Gasoline	0.6	2.5	7.57	20
Public Transportation (Inter-city Non-Business Trips)	Jet Fuel, Diesel & Electricity	1.7	6.8	-	54
(Intra-City Trips)	Diesel & Electricity	0.1	0.6	-	5
Waste heat, Elec. Power Generation	Coal, Oil, Gas & Nuclear	21.8	87.9	c)	704
Refinery Loss in Gasoline Production	Petroleum	5.9	24.0	c)	192
Totals		100%	403.7	$743.46	3,231 gals. of gasoline

Notes
a) For households so equipped.
b) Lawn Mowers, Boats, Motorcycles, etc.
c) Included in Price of Product.
d) Based on a weighted average of fuels supplying each item.

Title: Living With Limited Energy

Purpose: To acquaint the students with the method of reading an electric meter and interpreting an electric service billing

Materials: Copies of HOW TO READ YOUR METER (on next page), and a rate chart from your local electric utility company.

Procedure:

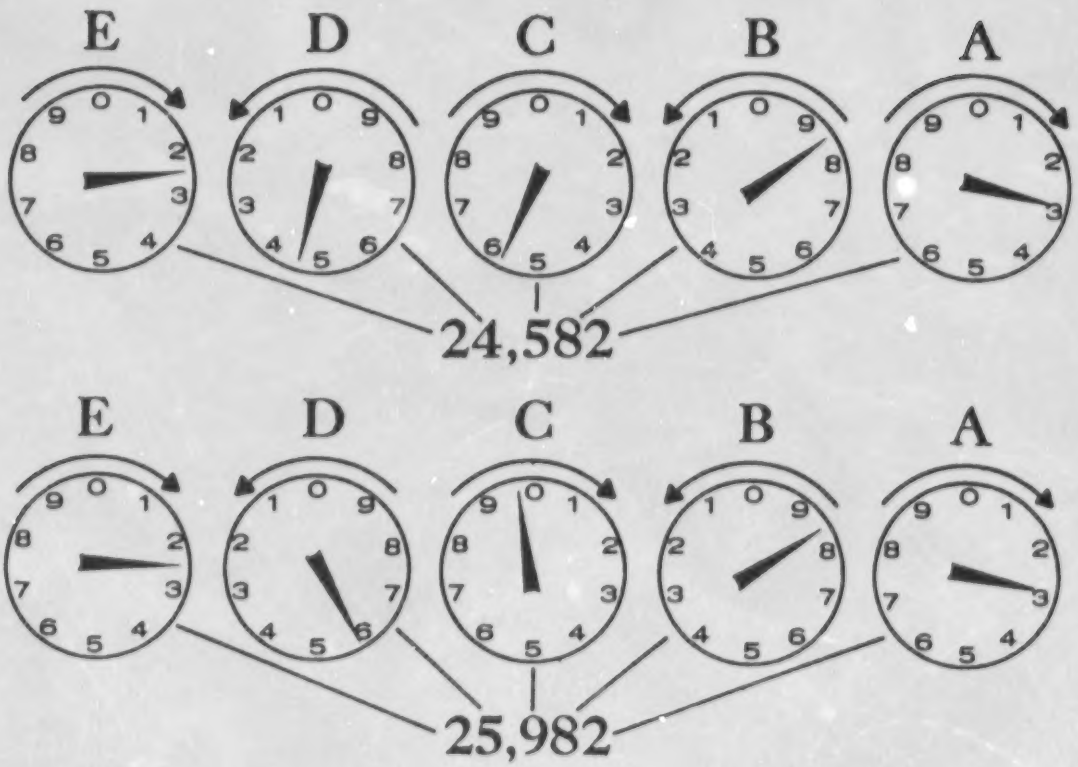
1. Distribute copies of HOW TO READ YOUR METER to all students and, with the aid of a master copy on the overhead projector, guide them through the steps in reading the electric meter. Be sure that the students understand the procedure by changing the positions of the dials and asking for new readings. (A large cardboard type of chart containing meters and movable dials could be constructed by one of the students and used for individual practice.)

2. Following the same basic procedure, guide the students through a reading and explanation of the indicated items on the electric service bill, giving special attention to the figures which indicate the kilowatt hours used.

   Several costs of operation of appliances in the home can be worked out using the rate chart obtained from your electric company.

3. Have students record daily kilowatt readings (at the same time each day) for one month, recording these data in a simple journal which should also include some observations about the temperature, appliance use, and other pertinent factors which might affect the amount of use of appliances.

HOW TO READ YOUR METER



Stand directly in front of the meter. Start with the right hand dial (a) and when the dial hand points between two numbers, write down the lower of the two numbers. Continue in the same manner, from right to left, with the other dials to obtain the correct reading. For example, the reading in the upper illustration is 24,582.

When a dial hand appears to be exactly on a number, as on dial (d) in the lower illustration, look at the dial (c) of the right. If the hand on dial (c) has not passed zero, the number 6 has not actually been reached on dial (d), and the reading on that dial is the next lower number - 5. The reading on dial (c) is 9.

For instance, if your reading last month was 24,582 and this month 25,982, the service used was the difference between the two numbers, or 1400 kwh.

Title: Life With Limited Energy

Purpose: To study individual family uses of electricity and/or natural gas

Procedure:

1. Learn how to read electric and gas meters. Actual electric meters are often available, on loan, from the local electric company. Cardboard models of electric and gas meters can be made easily by students who can then practice reading a variety of meter settings as they work in pairs or groups of three.

2. After mastering how to read the meters, ask every student to read the gas and/or electric meters in their homes at an agreed upon time (e.g., 5:00 p.m. on Wednesday). Indicate also that they will be reading the meters exactly one week later to determine how much gas and electricity they will be using in one week. Record the data for each family on a classroom chart.

3. After securing the baseline data for one week announce an "energy saving week." Urge each student to engage his family in seeing how much they can reduce their gas and/or electricity usage before the next weekly reading will be taken. Record the data for the second week. What family saved the most? The least? What was the average saving? Children from families that saved the most can be asked to explain how they were so successful. Was it hard or easy to save energy?

   Caution - This activity should be done, if possible, during a period of relatively stable temperatures such as dead of winter, early fall, or late spring. At other times, however, children can be helped to understand how changing outside temperatures affect energy use.

Title: Life With Limited Energy

Purpose: To examine varying demands for electricity in homes

Procedure:

1. During a study of electricity, all students should develop a clear understanding that the electricity available at the flick of a switch in our homes, schools, stores, factories, and other places cannot be stored. It must be produced as needed. During the days and hours when demand for electricity is very high, the electric power companies are required to use less efficient "stand-by" capacity to produce the needed electricity, thus resulting in a higher cost per KWH.

2. Involve the class in predicting the times when they would be using the most electricity in their homes. Try to get class agreement on the likely "ups and downs" of electrical use between 7:00 a.m. and 10:00 p.m.

3. Ask for student volunteers to read their home electric meters hourly on a Saturday and Sunday and bring the data to school Monday for class analysis. Do the data support their prediction?

4. How do they explain the high and low rates of use at different times? What suggestions can they make to spread some of peak hour demands to periods of lighter demand? Would they, personally, be willing to follow their own suggestions?

5. How might large communities, such as cities, juggle schedules to even out the electrical demand? Are the student suggestions feasible? Why or why not?

Title: Life With Limited Energy

Purpose: To determine how much it costs per month to operate various home electrical appliances.

Procedure:

1. Discuss with students the fact that they can calculate the cost of operating appliances in their homes when the following information is available:

   a. the appliance wattage
   b. the number of hours it operates
   c. the cost of electricity

2. Review with the class definitions of the following basic electrical terms: volt, amp, watt, kilowatt, and kilowatt-hour (KWH). Then give the class some sample problems using the following formulas:

$$\text{Watts} = \text{Amps} \times \text{Volts}$$

$$\text{KWH} = \frac{\text{Amps} \times \text{Volts} \times \text{Hours of use}}{1000 \text{ watts}}$$

$$\text{KWH} = \frac{\text{Wattage} \times \text{Hours}}{1000 \text{ watts}}$$

3. Ask the students to choose five home appliances that can be monitored for one month. Request that they locate (serial plate) or calculate (amps x volts) the wattage for each test appliance and record this information on their data chart. Also, have each student record the hours of use per day for each of the experiment's test appliances.

4. Suggest that an index card be taped to each test appliance so that any memeber of the family can record its "on" time.

5. While collecting data, calculate the KWH (wattage x "on" time) used per day for each test appliance.

6. Call the local electricity utility to find the average cost per KWH for all residential customers. It is possible to get a more accurate figure by dividing the amount of your electric bill by the number of KWH used during the billing months.

7. Operation for the test appliances can be determined by multiplying the KWH by the cost per KWH.

Example: A styling hair dryer uses 330 watts and its "on" time is 4 hours per month. How many KWH's are used, and what does it cost to operate?

$$KWH = \frac{\text{Wattage} \times \text{hours}}{1000 \text{ watts}}$$

$$KWH = \frac{330 \times 4}{1000} = \frac{1320}{1000} = 1.32 \text{ KWH}$$

8. Now to find the cost of operation, multiply the KWH by the cost per KWH ($.06).

$$1.32 \times .06 = .0792$$

The hair dryer would cost about $.08 to operate for one month.

9. The data collected during this activity will give each student an idea of how much it actually costs to operate a particular appliance for one month. In addition, each student could use his electric bill (total KWH's used) to determine what percentage of electrical power was required to operate that appliance.

Title: Living With Limited Energy

Purpose: To determine the most efficient and economical means of cooking meals

Procedure:

1. Have students choose a recipe for a roast or a cake. Have them prepare the food in an electric oven, a microwave oven, a toaster-oven, and a crockpot. Determine the wattage of each appliance by reading the labels on each. Next, convert this to kilowatts. Have students check the recipes for the time needed to bake or cook in each appliance. Multiply this time by the number of kilowatts. This converts the information into kilowatt hours. To determine the cost of using this much energy, multiply the kilowatt hours by the local cost per kilowatt hour.

2. Determine:

   a. What is the cheapest appliance to operate?
   b. Which appliance uses the least energy?
   c. Is there any difference in the quality of food cooked?
   d. In which appliance did the food cook best?
   e. How can you conserve energy in cooking?

GRADE 8, UNIT VI, LESSON 2

Title: Life With Limited Energy

Procedure:

1. Have students investigate how shortages in home heating fuels and the high cost of electrical energy generation have prompted utility companies, as well as the public, to look into energy conserving methods to help heat the home efficiently.

2. Have the students prepare a checklist of conserving projects for their homes. Then have the individual students survey their homes to see if the practices are in effect there.

3. Have students bring this information back to the classroom and discuss the problems that prevail.

4. After this large group discussion, have the students take back their findings to their parents.

   Topics for discussion should include amount of fuel wasted, effect on heating bill, and ways to alleviate the problems.

Title: Energy Conflict

Purpose: To examine conflicting demands for limited energy supplies

Procedure:

1. Divide the class into interest groups representing several of the major segments of energy users or groups concerned about the diminishing supply and rising cost of energy such as:

   a. manufacturers
   b. workers in manufacturing plants
   c. oil and gas companies
   d. truckers
   e. coal mine owners
   f. local and state government
   g. foresters
   h. farmers.

2. Ask each group to discuss the importance of the group they represent in the life of the community or state or nation. Ask them also to decide whether the percentage of energy they represent (with consideration for the total energy needs of the community) should be:

   a. increased,
   b. remain the same, or
   c. decreased if supplies become more limited and some type of allocation system must be developed.

3. After each group has presented its views to the class, ask each student to vote on what he believes to be the preferred allocation of energy to each segment of the community under conditions of greatly reduced supply.

4. What change, if any, would this produce in community and/or personal lifestyles?

GRADE 8, UNIT VII, LESSON 2

Title: Societies Change

Purpose: To demonstrate crowding stresses in roach populations

Materials: 1 gallon jar, unlimited food supply (bread, sugar, etc.), roaches

Procedure:

1. Place the roaches in a jar and give them an unlimited food and water supply.

2. Have students observe the population growth.

3. Graph the population increase. Note at what point the population stabilizes. (Alter the variables of water or temperature and graph their critical thresholds.)

4. Have students determine the critical thresholds of temperature, of food supply, of space, and water.

GRADE 8, UNIT VII, LESSON 2

Title: Societies Change

Purpose: To examine relationships between lifestyles and energy costs

Procedure:

1. Review with the class the fact that gasoline sells for $2.00 or more per gallon in many European countries such as Switzerland, Holland, Denmark, France, and Great Britain.

2. Divide the class into groups of three or four students. Ask each group to think about and develop a list of ways in which "lifestyles" in those countries with high gasoline costs are likely to be different from the ways people live in the U.S.A. where gasoline is cheaper than in any other highly industrialized country. Encourage the groups to think broadly beyond such obvious things as size of automobiles and number of superhighways. Types of family vacations, suburban sprawl, status of railroad passenger service, extent of air travel, use of recreational vehicles and many other elements of our lifestyle can be shown to be related to energy costs.

3. Ask each group, also, to make value judgments as to whether the lifestyle in high energy cost countries is worse or better than ours. Ask each group to state its conclusion on one or two specific examples and defend its position before the class.

Title: Societies Change

Purpose: To relate electrical energy needs to maintenance of present life-styles

To The Teacher:

It will be evident that this activity works best just prior to a five or more day vacation when the student is not required to be in school.

Procedure:

1. On the school day prior to the beginning of this activity, ask each student to survey his/her home and property after school and list every item that requires alternating current in order to function.

2. On the first day of this activity, make a composite list on the classroom blackboard of all the types of items named by the students.

3. Divide the students into small groups of 3-5 and have each group use the composite list to make the following sublists:

   a. Items "absolutely necessary"

   b. Items "difficult to do without"

   c. Items "you could live without"

   d. Items "that are nice to have"

   e. Items "entirely luxurious"

   Students' groupings will differ somewhat on where they sublist various items. These differences should be discussed to help them see their own hierarchies of needs.

4. On the classroom chalkboard, divide the items in the composite list into the 5 sublists based on general concensus of the class. Be sure each student now has these items so listed.

5. Now ask for student volunteers who will take part in the following experiment during their impending 5 (or more) day vacation. Volunteers will eliminate from their daily lives as many items as practicable according to the following form:

   Day 1. Eliminate all items in sublist e;
   Day 2. Eliminate all items in sublists e and d;
   Day 3. Eliminate all items in sublists e, d, and c;
   Day 4. Eliminate all items in sublists e, d, c, and b;
   Day 5. Eliminate all items in sublists e, d, c, b, and a.

6. Ask students to keep daily diaries during the course of the experiment.

7. Discuss diary entries as a group when school resumes.

8. Discussion should help students see what changes, if any, they would willingly make in their lifestyles to conserve energy; what changes may be reasonably imposed on them during an energy shortage and what they would consider unreasonable hardships during a shortage. This discussion also may lead into another activity on alternate energy sources, should the students not desire any reduction in energy consumption.

Title: Clean Air?

Objective: To investigate pollution from car emissions

Materials: newsprint, markers, resource materials on pollution

Procedure:

1. Write the following pollution facts on large pieces of newsprint, and post in a conspicuous place in the classroom.

   a) Automobiles generally cause more air pollution in cities than any other source. As much as 85% of air pollution in cities results from cars, trucks, and buses.

   b) Sickness from air pollution costs Americans about $4.6 billion yearly in medical treatment, lost wages for sick workers, and lost work. Damage to buildings, clothes, and other things cost about $12.3 billion every year. The yearly cost of air pollution in just these two areas is $16.9 billion or about $80 per person.

2. Divide students into partners or small groups and instruct each group to find one or more air pollution fact(s).

   If students have free access to the library, they may use those materials. Otherwise, have reference books, pamphlets, and newspaper articles about air pollution available in the classroom.

3. Have each group write the fact(s) on newsprint and post them in the classroom.

4. At the end of the class period, students should get together to share the facts they've discovered.

5. You might want to extend the learning experience with a discussion of car exhaust emissions, pollution control devices for automobiles and their effectiveness, pollution control laws, etc. Make sure students understand the concept that the visible pollution is only part of the car's exhaust. Many harmful pollutants (carbon monoxide, lead compounds, hydrocarbons) are invisible.

Title: Clean Air?

Objectives: To construct simple collectors and sample particulate emissions from exhausts, to observe the visible results of car and truck emissions, and to compare emissions from cars and trucks of different ages, makes, and sizes

Materials: pieces of cardboard, white tissue paper, tape, hand lens, large sheet of cardboard or Bristol board

Background Information: This activity tests only the solid particles which motor vehicles add to air pollution. The invisible particles (in the form of gases) are far more serious pollutants than the visible particles.

Procedure:

1. Ask students to construct a simple collector for testing particulate emissions.

   The collector is made by taping three to four inch squares of white facial tissue to a piece of cardboard a little smaller than the size of the tissue. Put four or five tissues on top of each other on the cardboard, fold the excess to the back of the cardboard, and tape it down.

2. Select a car at school to demonstrate the activity. While the car is running, hold the collector paper parallel to the mount of the exhaust pipe. The collector paper should be kept at a distance of six inches from the mouth of the exhaust pipe for two minutes.

   The car should be allowed to warm up before making this test. The motor should be idling and not racing and the brake should be on.

3. Students can then make several collectors for their tests. Emphasize the following safety precautions.

   a. Be sure to ask permission of the driver of a vehicle. A licensed driver should start the vehicle.

   b. The vehicle should be left in park or neutral while idling to ensure that no one is run over accidently. Keep the emergency brake on.

   c. Car exhausts give off invisible poisonous fumes. Keep your face as far from the exhaust as you can.

4. Ask the students to test a variety of vehicles. They can try to test different makes, models, and years of cars and perhaps test trucks and buses of varying sizes. Students may also test gasoline-powered lawnmowers as well as motorcycles of varying sizes.

5. For each vehicle tested, students should use a new collector and label it with the following information:

   a. the approximate year that the vehicle was made;
   b. the name of the company who made it and the model;
   c. the type of vehicle (truck, car, bus, motorcycle);
   d. the number of cylinders of the engine (4, 6, or 8 for cars);
   e. the type of fuel burned in the engine (regular, no-lead, premium gasoline, or diesel fuel).

6. When all tests are complete, have students examine the collector papers with a hand lens. Ask them to record:

   a. the size of the particles, either small, medium, or large;
   b. the color, such as light gray, dark gray, black;
   c. the density of the particles;
   d. other observations.

7. Obtain a large sheet of cardboard or Bristol board. Ask students to arrange the collector papers, in order, from the exhaust with the worst solid particle air pollution to the exhaust with the least, and glue them onto the cardboard. Label the sources of worst to least pollution papers.

8. Give the display an appropriate title and post it in the classroom.

9. Ask students:

   Why would better results be obtained if two types of collector papers were used instead of just one type?

   Why should all the collector papers be held at the same distance and for the same length of time for each exhaust?

   Why should the motors be warmed up and running at the same speed?

   What types of particles from the exhausts match the types of particles found in the locations tested in the other activities?

   Is there any relationship between the amount of pollution and the age of the car, the number of cylinders, the type of fuel used, the degree to which the motor is warmed up? How could you test to see if you are right?

VOCABULARY - "ENERWORDS"

Ampere - A unit of measure for electric current.

Appliance - A device which does a special job, usually electric.

Barrel - A liquid measure of oil, usually crude oil, equal to 42 gallons or 306 pounds.

Bituminous Coal - Soft coal, high in volatile matter.

British Thermal Unit (BTU) - A unit of heat energy - the amount of heat necessary to raise the temperature of one pound of water one degree Fahrenheit.

Brownout - The lowering of power supplied to customers by a power company when power demand exceeds generating capacity.

Calorie - A unit of heat equal to the amount of heat necessary to raise the temperature of one kilogram of water one degree Celsius; equal to 1000 small calories.

Carbon Dioxide - A compound of carbon and oxygen formed when carbon or carbon materials are burned or used in the body.

Carbon Monoxide - A compound of carbon and oxygen formed when carbon or carbon materials are incompletely burned. When formed in automobiles, it becomes a major air pollutant.

Catalytic Converter - A device placed on the exhaust of an automobile that changes carbon monoxide and hydrocarbons, which cause air pollution, to carbon dioxide and water.

Centigrade - See Celsius.

Celsius - A temperature scale which runs from zero degrees (the temperature of melting ice) to one hundred degrees (the temperature of boiling water). Sometimes called centigrade.

Charcoal - A porous, solid residue resulting from the incomplete combustion of wood or bone.

Chemical Energy - Energy stored in the structure of atoms and molecules, which can be released by a chemical reaction.

Clean Fuel - A low sulfur fuel.

Coal - A solid organic material formed by the decomposition of plant material without air, containing 75% carbon.

Coal Gas - "Fuel gas," the gas formed when coal is partially burned to make coke. Has 1/3 the energy of natural gas.

Coal Gasification - The process which converts coal to a gas.

Coal Liquification - The process which converts coal to a liquid fuel by the addition of hydrogen.

Coal Tar - A black, gummy substance produced when coal is distilled.

Coke - A porous, solid residue resulting from the incomplete combustion of coal heated in an oven with a limited supply of air. A good fuel, more nearly pure carbon than coal.

Combustion - Burning, a chemical reaction producing heat and light and, in some cases, a flame. Usually a combination of carbon and oxygen.

Conduction - The transmission of energy directly from one substance or molecule to another.

Conserve - To keep from being lost, wasted, or damaged.

Convection - The transfer of energy by moving masses of liquid or gases.

Conversion - The process by which energy is changed from one form to another.

Cooling Tower - A structure for cooling waste water from power plants.

Cord - A measure of wood volume - a stack four feet by four feet by eight feet.

Cracking - The process of breaking down the molecular structure of heavy hydrocarbons into lighter hydrocarbons, as when gasoline is produced from crude oil.

Crude Oil - A mixture of hydrocarbons in liquid form found in underground reservoirs; the raw material from which most refined petroleum products are made.

Depletion Allowance - A tax exemption for a portion of the revenue received from depleting a natural energy resource (e.g., removing oil from a well).

Dry Steam - Steam so hot it contains no water droplets.

Ecology - The study of relationships between living things and their environment.

Efficiency - The ratio of the work or energy output to the energy input to do the work.

Electric current - A flow of charged particles, usually electrons.

Electrons - Negatively charged particles that orbit the nucleus of an atom. A chemical reaction consists of the transfer and rearrangement of electrons between atoms.

Electrostatic Precipitator - A device that removes waste particles from the exhaust of power plants by attracting them to electrically charged plates from which they can be washed away, thus preventing air pollution.

Energy - The ability to do work; to move a force a certain distance. It exists in many forms and can be converted from one form to another.

Energy Density - The energy per unit of weight in a fuel.

Energy Intensiveness - A measure of energy utilitization. For example, the number of calories used to move a passenger one mile.

Environment - Everything that is not you - and you.

Environmental Impact Statement - A predicted analysis of the impact on the environment of a projected activity. For example, the mining of coal, or offshore drilling for oil.

Fahrenheit - A temperature scale which uses 32 degrees as the melting point of ice and 212 degrees as the boiling point of water, named after its inventor.

First Law of Thermodynamics - The law of conservation of energy, which states that energy can neither be created nor destroyed.

Fission - The splitting of atoms (heavy nuclei) to release energy.

Food - The fuel used by animals, including man, to produce "body power."

Food Chain - The pathway over which any food material passes from the producing organism to consuming organisms.

Force - The power exerted on an object to produce motion or change of direction.

Fossil Fuel - A natural fuel such as coal, oil, or natural gas, formed from the fossil remains of living things.

Fuel - A substance that can be burned to produce heat.

Fusion - The joining together of atoms to release energy.

Gasoline - A fuel composed primarily of light hydrocarbons, produced by "cracking" crude oil in a refinery.

Generator - A device which produces electric energy from mechanical energy, as in a motor or water turbine.

Geothermal Energy - Heat energy within the earth which produces steam when it comes in contact with water.

Geyser - A spring from which hot water and steam shoot into the air.

Greenhouse Effect - The warming effect of the carbon dioxide in the atmosphere which allows solar radiation to reach the earth but which absorbs (and keeps in) the heat radiation from the earth.

Harness - To control so as to use the power of, as of steam.

Heat - A form of kinetic energy resulting from the movement of molecules in matter. It flows from one body to another if there is a temperature difference between them.

Heat Engine - A device which converts heat energy into mechanical energy.

Heat Pump - A device which transfers heat from one place to another by using electric or mechanical energy. It can pump warm air into a building to heat it, or out of a building to cool it.

Heat Sink - Any substance that absorbs waste heat - air, water, or space.

Heat Tax - The heat energy that is lost when energy is converted from one form to another.

Horsepower - A unit of power equal to 746 watts.

Hydrocarbons - Molecules made up of hydrogen and carbon atoms in various proportions, usually formed by living things.

Hydroelectric Plant - An electric power plant in which electricity is generated by using the energy of falling water to turn turbines.

Indirect Energy - Any form of energy used to provide goods and services, which themselves may or may not use energy.

Joule - A unit of energy or work; the amount produced by a force of one newton operating through the distance of one meter, named after its inventor.

Kerosene - A fuel used in jet engines and gas turbines, made up of a mixture of hydrocarbons by "cracking" crude oil in a refinery. Its hydrocarbons are heavier than those in gasoline or naphtha.

Kilowatt - A unit of electric power equal to 1000 watts.

Kilowatt-hour - A unit of energy or work equal to the use of one kilowatt of energy for one hour.

Kinetic Energy - The energy of motion; the ability of an object to do work because of its motion.

Laser - A device which can produce high intensity radiation by forcing the atoms or molecules in a material to radiate at the same time, rather than independently, as in a light bulb.

Light - Electromagnetic radiation which can affect the eye.

Light Water Reactor - A nuclear reactor in which water is the primary coolant or moderator.

Liquified Natural Gas (LNG) - Natural gas that has been turned to a liquid by cooling it to minus 160 degrees Celsius, thus reducing its volume and making it easier and cheaper, and probably more dangerous, to store and ship.

Machine - A device which uses energy to do work.

Mechanical Energy - A form of energy which is seen as the motion of an object.

Megawatt - A unit of power equal to 1000 kilowatts or one million watts.

Moderator - The material (water, graphite, etc.) used in a nuclear reactor to control the rate of fission.

Natural Gas - A natural mixture of hydrocarbons found in porous rocks under the earth's surface, usually in association with petroleum. It is almost pure methane.

Non-renewable - Not able to be replaced once used up, as oil.

Nuclear Energy - Atomic energy, the energy released by changes in the nucleus of an atom in a reactor.

Nucleus - The dense, positively charged core of an atom.

Off-peak Power - Power generated during a period of low demand.

Oil Shale - A sedimentary rock containing the material kerogen, which can be recovered as oil when the rock is heated at high temperatures.

Particulates - Small ash and soot particles produced in burning.

Peak Load - The maximum amount of power which a plant can produce in a given period of time.

Petrochemicals - Chemicals derived from petroleum.

Petroleum - An oily, flammable liquid mixture of hydrocarbons that may vary from almost colorless to black, found in sedimentary rocks, and providing the raw material for a host of fuels and synthetic materials.

Photosynthesis - The process by which green plants convert the radiant energy of the sun into chemical potential energy when carbon dioxide and water are converted into carbohydrates.

Photovoltaic Process - The process by which radiant energy is converted directly into electric energy.

Pollution - Contamination or fouling of land, air, or water, by chemicals, heat, noise, atomic radiation, or wastes.

Potential Energy - Stored energy, as in a battery or water behind a dam.

Power - The rate at which energy is used or work is done, measured in units of energy per unit of time (calories per second) or in units such as kilowatts or horsepower.

Primary Energy - Energy in its natural form, such as coal or oil, before its conversion to end-use forms of energy, such as heat or electricity.

Radiation - The emission of energy through matter or space.

Reserves - Portions of a resource, such as oil, which have been discovered and can be extracted by available technology.

Resource - A product of nature which people use to satisfy their needs, wants, and dreams.

Second Law of Thermodynamics - In any energy conversion, some energy passed from a useful to a less useful form, usually lost heat, or "heat tax."

Smog - An atmospheric condition in which the air is polluted by smoke, fog, sulphur and nitrous oxides. Sulphur oxides react with water to form sulphuric acid droplets, which fall as "acid rain," causing great damage to marble and limestone buildings and statues, and to bodies of water which become too acidic to support living things.

Solar Cell - A device which converts solar radiant energy directly into electric energy by the photovoltaic process.

Solar Collector - A device for collecting solar energy and converting it into heat.

Solar Energy - The electromagnetic radiation transmitted by the sun. The earth receives about 4000 trillion kilowatt-hours per day.

Synthetic Natural Gas (SNG) - A gaseous fuel manufactured from coal, containing almost pure methane.

Tar Sand - A sandy geologic deposit in which oil is found.

Temperature - The "hotness" or "coldness" of a substance.

Thermal Pollution - Any increase in air or water temperature by waste heat from electric generating plants, which causes disturbances in the ecological system of an area.

Turbine - A motor turned by a powerful stream of water or gas.

Uranium - A radioactive, metallic element used as a fuel in nuclear power plant reactors to generate electricity.

Utility - A company or organization which provides services for people, such as gas, oil, or electricity.

Volt - The electromotive force which will cause a current of one ampere to flow through a resistance of one ohm.

Watt - A metric unit of power used in electric measurements of the rate at which work is done or energy used. One watt equals one Joule of work per second.

Work - The product of a force multiplied by the distance the force is applied or the object is moved.

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REVIEW SHEET (6-8)

This teachers' guide, Energy and My Environment (6-8), is for your review, field testing and comments. Your evaluation of these lessons will be sincerely appreciated and your suggestions considered for inclusion in a revised publication.

Sections of Guide Taught

Grade ___ Unit ___ Lesson ___ Grade ___ Unit ___ Lesson ___

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Grade ___ Unit ___ Lesson ___ Grade ___ Unit ___ Lesson ___

Are lessons appropriate for grade level? _____

_____

Describe reaction of students. _____

_____

Is there sufficient emphasis on teaching energy facts? _____

_____

Is there sufficient emphasis on teaching values? _____

_____

Your ideas for extending the lessons:

Grade ___ Unit ___ Lesson ___ _____

_____

Grade ___ Unit ___ Lesson ___ _____

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Grade ___ Unit ___ Lesson ___ _____

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Please put additional ideas on back of review sheet; include the grade, unit and lesson numbers.

Other comments and suggestions: _____

_____

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Reviewer: _____

Title: _____

School _____ County _____

Address: _____

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